Norske Fina a/s
Finagården, Ringsveien 3
Postboks 8, 1321 Stabekk

FINA

11 FEB. 1983

Folldal Verk A/S
Ruseløkkvn. 26

OSLO 2

Stabekk 9th February 1983
Deres ref
Vår ref Mining - OL/Lo

Dear Sirs,

Regarding Management meeting 15.03.1983 at 09.00 a.m.

Enclosed you will find:

a. Agenda for the meeting 15.03.1983.

b. Summary of Exploration works 1982.

c. Joint Account 1981 and 1982.

d. Exploration program 1983.

e. Budget 1983.

Regards,
for NORSKE FINA A/S

Olav Limyr

Olav Limyr

Encl.

JOINT VENTURE

FOLLDAL VERK A/S - NORSKE FINA A/S

Management meeting 15-03-83

Agenda

1. Results of exploration works in:

   A. Ørsdalen area

   B. Knaben area

   C. Gursli area

   D. Various fields

2. Joint Account 1981 and 1982

3. Exploration Program 1983

4. Budget 1983

5. Various

Stabekk, 08.02.83.

[signature]

JOINT VENTURE

FOLLDAL VERK A/S - NORSKE FINA A/S

SUMMARY OF EXPLORATION WORKS 1982

The exploration in 1982 covered:

1. Extensive geological survey in the Ørsdalen area.

2. Initiate investigation at the Gursli mine.

3. Geochemical exploration in the:

   a. Vikeså - Ålgård area
   b. Vigelandsvatn area
   c. Lyngdal area.

4. Determination of the MoS_2 content and byproduct minerals in the Knaben II tailings.
   Evaluation of previous geological survey and exploration works.

The mentioned exploration areas are within the Area of Interest in the Exploration Agreement between Folldal Verk A/S and Norske Fina A/S (South of latitude 59 N, west of Setesdalen) Map 1.

Ørsdalen

Three individual high grade lenses are known from previous mining, Map 2.

The diamond drilling in 1972 and 1981 did not succeed in finding continuous and high grade mineralization. The expectation to the area are still based on the high grade ore from the three old mines. Therefore, instead of continued diamond drilling, it was decided this year to do a detailed structural/lithological mapping with the intension of obtaining a geological/mineralization model, which could form basis for continued investigation.

It has been possible to follow the low grade mineralized zone down the valley wall and into the drifting Stoll I.
One high grade lens was found near the top of the mountain. No areas in the exploration driftings Stoll I and Stoll II contains above 0,1% WO_3.

The geometry of the mineralized zone is determined, and when all relevant information from 1982 and previous investigation are taken into consideration the rock volume of potential high grade lense is diminished.

Our conclusion is that there may exist several hidden separate lenses, but the potential rock volume and anticipated size of each lense make it unlikely that the total mineralization shall be of economical value.

oppfølging av mineraliseringen nord for dalen

Gursli

The old molybdenite mine at Gursli was worked in several periods from 1914 - 1925.

Two types of mineralization can be recognized at Gursli, MoS_2 in quarts veins and MoS_2 in anorthosite. The later high grade ore are considered as the only worthwhile exploration target.

This part of the mine was investigated in 1925 by a 12 m deep shaft. This shaft is now filled with water. Last summer we tried to empty the shaft in order to do sampling and mapping, but because of inflowing water it could not be done. Later we learned that the exploration works in 1925 was stopped due to water problems, and this my explain why the high grade mineralized anorthosite not has been mined out.

Further exploration should be diamond drilling to investigate the continuation of the mineralized anorthosite at depth.

Geochemical exploration

Stream sediments was sampled and analysed from three areas. Lyngdal, Vigelandsvatn and Vikeså-Ålgård.

Pb-Zn anomalies was found 5 km north of Vikeså. In the Lyngdal area weak Mo-anomalies were registrated. These anomalies will be followed up next summer with further sampling and analysis.

Knaben

The Knaben area is the oldest and largest molybdenum mining district in Norway. From 1885 to 1972 the district produced 18.800 tons of MoS_2 from 8,8 mill. tons of ore.

The investigation in the Knaben area last summer was directed partly towards sampling of the tailings from Knaben II mine, and partly towards an interpretation/evaluation of the current knowledge on the mineralization and on the previous exploration activities.

It has been demonstrated that a lens with mineral enrichment exists within the tailings. The size of this lense is estimated to 0,5 mill. tons with 0,062% MoS_2. The grade and tonnage is too low to be of any economical potential.

There exist several mines in the Knaben area - Map 3. Of these Knaben II dominates with a 12 million tons orebody. Second is Kvina with 100.000 tons of ore and third Knaben I with 80.000 tons of ore.

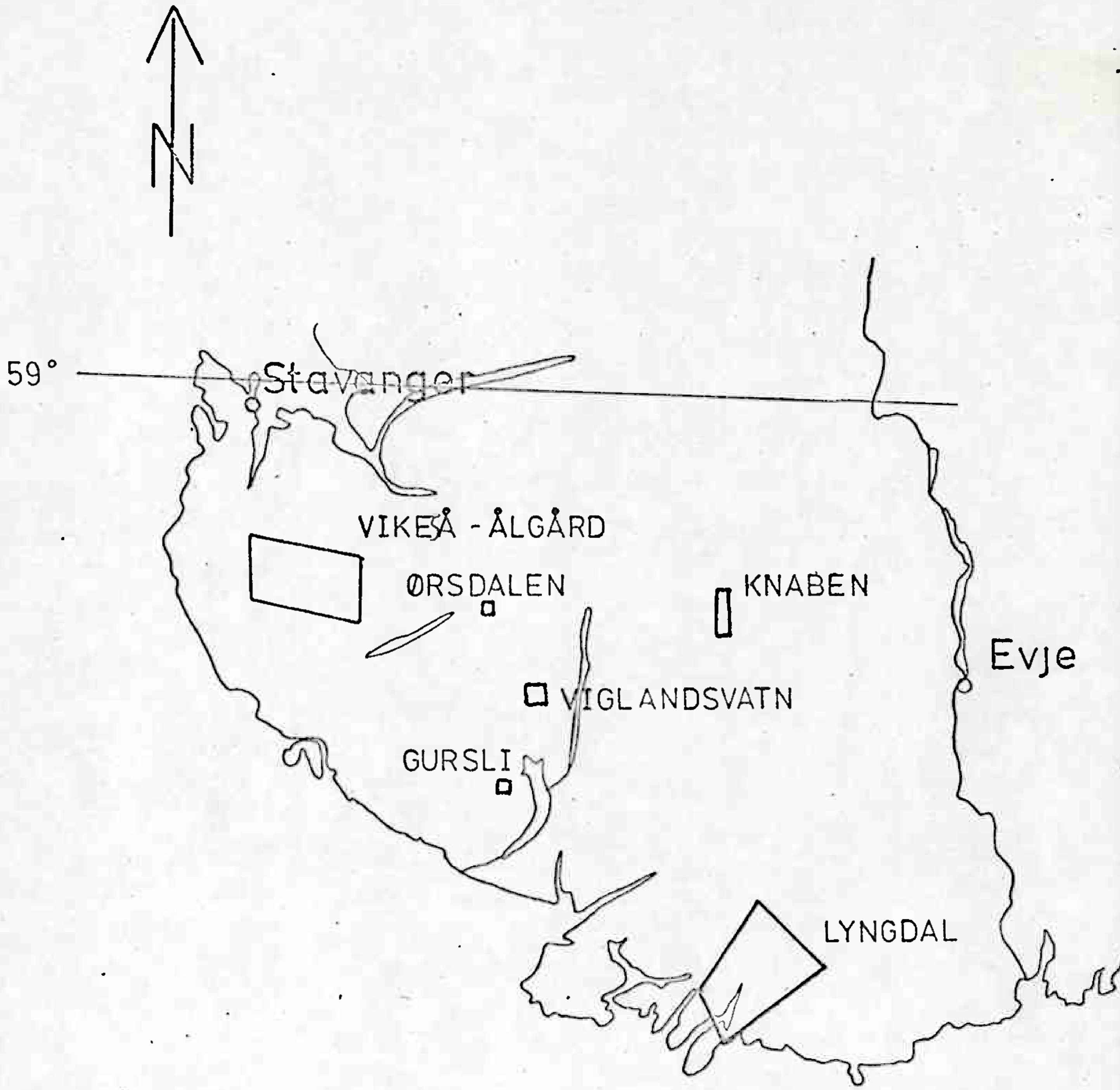
It is proposed that horizons of gneiss (fahlbånd) Map 3 has controlled the mineralization in the Knaben area. This gneiss horizon is folded and both Kvina and Knaben II is situated below anticlines.

At Knaben II the anticline has faciliated the formation of an elongated and large orebody. The only other orebody with an elongated geometry is the Kvina deposit. It is proposed that the zonarity seen in the Knaben II is the result of cooling of Mo-bearing hydrotermal solutions and that the ore at Kvina represents formation at an even lower temperature than

Knaben II. This opens the possibility that an orebody at Knaben II model may be found south of Kvina.

It is proposed next summer to continue with diamond drilling along the axis of the Kvina orebody. It must be noted that none of the previous diamond drillings have tested this mineralization model.

11.1.1983.



MAP 1

NORSKE FINA A/S

Locality map
SW-NORWAY
1:1000000

JLP oct 82

NORSKE FINA A/S
12/2-82

JOINT VENTURE - ØRSDALEN

1981

Travel Accounts:	9204	Travel & Diet Expences		80.864,96
Administration:	9301	Copying		1.500,15
Consumption:	9401	Electricity	12.412,60	
	9411	Fuel Oil	7.868,50	
	9420	Tools	5.372,26	
	9429	Misc.Accessories	1.862,04	
	9431	Documents	492,53	
	9433	Topographical Survey	36.911,85	
	9434	Inclination Survey	12.875,20	77.794,98
Outside Servings	9501	Analysis and lab. tests	81.273,72	
	9504	Geological Assistance	68.813,94	
	9505	Diamond Drilling	293.519,-	
	9509	Other Outside Services	6.809.34	
	9550	Helicopter Transport	103.508,33	
	9559	Other Transport	36.015,29	
	9560	Repair of Barrach	88.288,05	
	9569	Misc. Establishing Expences	8.894,05	687.121,72
Internal Charges:	9680	Salaries and Charges		114.000,-
				961.281,81

for NORSKE FINA A/S
Joint Account Ørsdalen

Olav Limyr (signed)   Toralf Nordbotten (signed)

Olav Limyr   Toralf Nordbotten

JOINT ACCOUNT 1982

Folldal Verk A/S - Norske Fina A/S

Travel Accounts	9204	Travel & Diet Expenses	5.648,15	
	9207	Meeting Expenses	868,50	6.516,65
Administration	9301	Copying		1.139,64
Consumption	9411	Fuel Oil	1.965,-	
	9420	Tools	952,83	
	9429	Accessories	6.729,65	
	9430	Maps	4.493,15	
	9431	Documents	624,-	14.764,63
Outside Service	9501	Analyses and Laboratory Tests	38.058,-	
	9504	Geological Assistance	168.889,19	
	9509	Sampling of tailings, Knaben	30.665,-	
	9550	Helicopter Transport	4.275,-	
	9559	Other Transport	3.790,-	245.677,19
Rents	9609	Rent Houses	5.995,-	
	9609	Rent Machines	13.854,50	19.849,50
Insurance	9629	Insurance Personel		3.780,-
Public Fees	9639	Public Fees		300,-
Internal Charges	9670	Folldal Verk A/S		12.033,54
	9680	Norske Fina A/S		50.000,-
				354.061,15

Share:

Norske Fina A/S - 100%		1.000.000,-			
Expenses 1981		961.281,81		38.718,19	
		354.061,15			
	- 80%	38.718,19	315.342,96	252.274,36	290.992,55
Folldal Verk A/S	- 20%		315.342.96		63.068.60
					354.061,15

for Norske Fina A/S

Joint Account Folldal Verk A/S - Norske Fina A/S

Olav Limyr Per Egil Andersen

JOINT VENTURE

FOLLDAL VERK A/S - NORSKE FINA A/S

Exploration program 1983

Our main target this year is the Knaben area. It is proposed to drill south of the Kvina mine in the elongation of the axis of the orebody. This program includes 6 drill holes with a total length of 1420 m. Details about this program can be seen in attached table 1 and map.

We have also plans to carry out detailed geological mapping in selected fields, and geochemical investigation of the various gneiss types in order to detect chemical variations related to the metalliferous zones.

Regarding previous year geochemical exploration we have the intention to follow up the anomalies found in the Vikeså-Ålgård area and in the Lyngdal area.

At the Ørsdalen and Gursli mines we have no plans for doing any exploration works this year.

Stabekk, 08.02.83.

Locality	Profile	Hole no.	Dip	Altitude at beginning of the hole	Altitude of expected intersection	Length of hole to expected intersection	Length of hole if no mineralization is met
Kvina	1	1	90^{o}	840 m asl	760 m asl	80 m	200 m
Kvina	1	2	90^{o}	870	660	210 m	260 m
Kvina	2	3	90^{o}	850	750	100 m	200 m
Kvina	2	4	90^{o}	860	620	240 m	280 m
Kvina	3	5	90^{o}	890	650	230 m	280 m
Knaben I	-	6	90^{o}			140 m	200 m
							1420 m

Table 1 Proposal for a diamond drilling program in the Kvina - Knaben I area.

For position of the drillholes, see Map 18.

Budget 1983

Joint Venture

Folldal Verk A/S - Norske Fina A/S

			000 NOK	000 NOK
Travel Accounts:	9204	Travel & Diet Expenses		80
Administration:	9301	Copying		2
Consumption:	9401	Electricity	15	
	9411	Fuel Oil	25	
	9420	Tools	5	
	9429	Misc. Accessories	5	
	9431	Documents	3	53
Outside Services:	9501	Analysis and lab. tests	100	
	9504	Geological Assistance	120	
	9505	Diamond Drilling	700 1500 ←	
	9509	Other Outside Services	10	
	9550	Helicopter Transport	120	
	9559	Other transport	50	
	9569	Misc. Expenses	20	1.120
Rents:	9606	Rent Houses		50
Public Fees:	9639	Licence Fee		20
Internal Charges:	9680	Salaries and Charges		150
Total Budget				1.475

Stabekk, 08.2.1983

R. Linnegh

JOINT ACCOUNT 1982

Folldal Verk A/S - Norske Fina A/S

Travel Accounts	9204	Travel & Diet Expenses	5.648,15	
	9207	Meeting Expenses	868,50	6.516,65
Administration	9301	Copying		1.139,64
Consumption	9411	Fuel Oil	1.965,-	
	9420	Tools	952,83	
	9429	Accessories	6.729,65	
	9430	Maps	4.493,15	
	9431	Documents	624,-	14.764,63
Outside Service	9501	Analyses and Laboratory Tests	38.058,-	
	9504	Geological Assistance	168.889,19	
	9509	Sampling of tailings, Knaben	30.665,-	
	9550	Helicopter Transport	4.275,-	
	9559	Other Transport	3.790,-	245.677,19
Rents	9609	Rent Houses	5.995,-	
	9609	Rent Machines	13.854,50	19.849,50
Insurance	9629	Insurance Personel		3.780,-
Public Fees	9639	Public Fees		300,-
Internal Charges	9670	Folldal Verk A/S		12.033,54
	9680	Norske Fina A/S		50.000,-
				354.061,15

Share:

Norske Fina A/S - 100%		1.000.000,-			
Expenses 1981		961.281,81		38.718,19	
		354.061,15			
	- 80%	38.718,19	315.342,96	252.274,36	290.992,55
Folldal Verk A/S	- 20%		315.342,96		63.068,60
					354.061,15

For Norske Fina A/S
Joint Account Folldal Verk A/S - Norske Fina A/S

Olav Linmyr (signature) Per Egil Andersen (signature)

Olav Linmyr Per Egil Andersen

MINERAL EXPLORATION IN 1982 IN THE ØRSDALEN, GURSLI, KNABEN, LYNGDAL, VIKESÅ-ÅLGÅRD AND VIGLANDSVATN AREAS IN SW-NORWAY

BY

NORSKE FINA A/S - FOLLDAL VERK A/S

JOINT VENTURE

KØBENHAVN, NOVEMBER 1982

John Pedersen

JOHN PEDERSEN

The open pit at Knaben II with the tailing pond and the Knaben townsite in the background.

LIST OF CONTENTS

MAPS NO 1 TO 23:

ABSTRACT

The prospection activity by the Norske Fina A/S - Folldal Verk A/S joint venture in 1982 in SW-Norway included detailed investigations around the old Mo/W mines at Ørsdalen, Gursli and Knaben and regional investigations in the Lyngdal, Vikeså-Ålgård and Viglandsvatn areas.

The investigations include detail mapping of surface outcrops and underground workings, geological reconnaissance, compilation and evaluation of existing information, sampling of the tailing at Knaben II, traverses with UV-lamps and drainage geochemistry.

The results include:
- A better understanding of the structure in the Ørsdalen area, which has diminished the potential for an economic ore body.
- A presentation of a mineralization model in the Gursli area which may be of economic potential.
- A structural/mineralization model of the Knaben area. The continuation along the plunge of the old Kvina mine is proposed to hold a potential for an economic ore body.
- A determination of the MoS_2 content in the Lille Knabetjern tailing bassin. The overall MoS_2 content is o,o3o %. A higher grade lens of o,5 mill tons contains o,o6 % MoS_2.
- The identification of a Pb-Zn anomaly around the Fauerfjeld metasediments in the area north of Vikeså.

The recommendations include:
- A diamond drilling program in the area south of the old Kvina mine in the Knaben area.
- A diamond drilling program around the old Gursli mine.
- Follow-up of the Pb-Zn anomaly north of Vikeså.

INTRODUCTION

The exploration activity in 1982 was done on behalf of the Norske Fina A/S - Folldal Verk A/S joint venture, which has the purpose to do mineral exploration in SW-Norway within the area bordered by Setesdalen in east and a line from Evje to Stavanger in north (Map 1).

The aim of the investigations was to define targets for continued and progressed exploration. The main effort has been directed towards investigation of the old molybdenum-tungsten occurrences in SW-Norway, but other possibilities have also been investigated. Detailed mapping and evaluation of current and new information were done at the old molybdenum/tungsten mines at Ørsdalen, Gursli and Knaben. Regional and follow-up geochemistry were done in the Lyngdal, Vikeså-Algård and Viglandsvatn areas. Further, the tailing from the old Knaben II mine was sampled in order to determine the content of molybdenite.

Norske Fina A/S has been operater on the project with Olav Limyr as projectleader. John L. Pedersen has been employed as senior geologist for 5 month. The fieldseason lasted from ultimo may to ultimo august. During that period three junior geologists, Jan Inge Tollefsrud, Sven Dahlgren and Per Erik Øverli were employed for shorter periods in june. Henrik Nielsen was assistent for JLP in july and august. The sampling of the tailing was done with the support of a local contractor. For a detailed account of the fieldseason, see the diary (appendix A).

During the fieldseason 34 heavy-mineral samples, 173 stream sediment samples, 252 tailing samples and several rock samples were collected. Analyses have been done by Robertson Research Ltd. Wales.

GENERAL GEOLOGY AND MINERALIZATION

The area selected for exploration in SW-Norway belongs to the South Norwegian metamorphic complex. It comprises high-grade mainly granitic, metamorphic rocks of both sedimentary and intrusive origin, and late-tectonic, mainly granitic or anorthositic intrusives. The metamorphic rocks have been described in the western part by Michot (1960), in the central part by Hermans et al. (1975) and in the eastern part of the area by Falkum (1973). The late-tectonic intrusives include the anorthositic Egernsund intrusives (Michot & Michot, 1969), the granitic Farsund intrusives (Middlemost, 1968), and the granitic and amphibolitic intrusives in the Iveland-Evje area (Pedersen, 1975). Within the metamorphic rocks two metamorphic episodes can be discriminated, one between 1500 m.y. and 1200 m.y. and the other between 1000 m.y. and 800 m.y. (Versteeve, 1975). The late-tectonic intrusives are 1000 m.y. to 800 m.y. old (Pedersen, 1981).

A review on the mineralization types which occur in the area is given by Bugge (1978). A summary on the different rock units and their known or assumed potential for various types of mineralization is presented in Table 1. Detailed accounts on the geology are given in the areal descriptions.

	ROCK UNITS	KNOWN MINERALIZATION	POTENTIAL MINERALIZATION	LOCALITIES INVESTIGATED
Late-tectonic intrusives	The granitic and amphibolitic intrusives at Evje	Ni-Cu in ultramafic rocks	-	
	The granitic Farsund intrusives	Magmatic Fe, Ti, Mn	Porphyry-type Mo, Cu	Lyngdal
	The granitic Ålgård/Sjelset intrusives	-	Porphyry-type Mo, Cu Contact-type Sn, Cu	Vikeså-Ålgård
	The anorthositic-noritic intrusives at Egernsund	Magmatic Ti, Fe, V, Ni	(Mo)	(Gursli)
Metamorphic complex	The Fauerfjell metasediments	-	Stratabound Pb, Zn, $BaSO_4$	Vikeså-Ålgård
	The augengneisses	-	-	
	Iron-sulphide and graphite-bearing garnet gneiss	Stratabound Cu	Mo, W	Viglandsvatn
	Grey banded gneisses	Quartzvein/Stratabound Mo, W, Cu	Ag, Au	Ørsdalen, Gursli, Knaben I
	Massive quartz-feldspar gneisses	Pneumatolytic/Pegmatitic Mo, Cu	Ag, Au	Knaben II, Kvina

Table 1. Schematic presentation of rock units, their known or potential mineralization and localities investigated in 1982 in SW-Norway.

ØRSDALEN

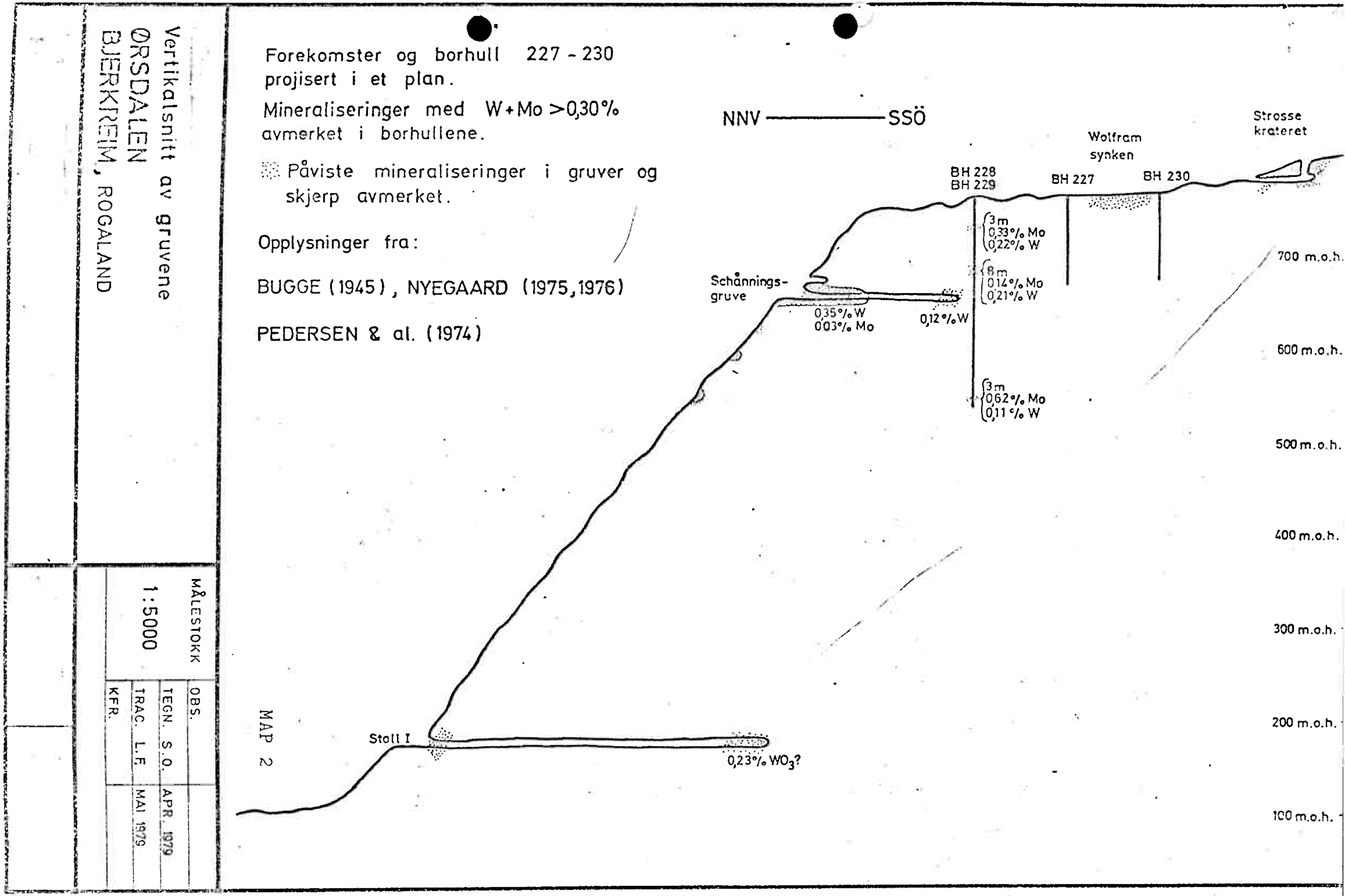
Previous work.

The old molybdenum-tungsten mine in Ørsdalen (Map 1) is situated on the mountain plateau just south of the valley. Mining took place for shorter periods from 19o4 to 1953 and was concentrated around three small mines (Map 2). Strossekrateret was the first to be worked. It produced 55 tons of MoS_2 from an estimated 5ooo to 7ooo tons of ore. Wolframsynken and Wolframstrossen produced 18 tons of WO_3 from 3ooo to 5ooo tons of ore, and Schånningsgruben produced 32 tons of WO_3 from 5ooo to 7ooo tons of ore. These values indicate a grade of c. 1 % MoS_2 and c. o,5 % WO_3.

Exploration activities have continued from the mining period and until today. In the forties and fifthies exploration-drifting at the valley bottom (Stoll I and II) resulted in the finding of low grade tungsten mineralization, as diamond drilling on the mountain plateau (DB 1-5, Map 2) not gave any positive result. Urban (1971) gave a mineralogical description of the deposit. In the seventhies Folldal Verk A/S undertook detail mapping on the mountain plateau (Nyegaard, 1976), bulksampling from Schånningsgruben (Pedersen et al., 1974) and diamond drilling of four holes on the mountain plateau (DDH 227-23o, Map 2) (Nyegaard, 1975). The claims were returned to the government, which undertook a compilation of all relevant data and did an evaluation of the prospect (Olerud, 198o). In 198o the joint venture Folldal Verk A/S - Norske Fina A/S took over the claims and continued with diamond drilling of three holes (DDH 231-233, Map 2) (Nyegaard, 1981).

Activities.

None of the above mentioned exploration activities had succeeded in finding continous and high grade mineralization. The expectation to the area still being based on the high grade ore from the three old mines. Therefore, instead of continued diamond drilling it was decided this year to do a detailed structural/


Vertikalsnitt av gruvene
ØRSDALEN
BJERKREIM, ROGALAND
MÅLESTOKK
1:5000
OBS.
TEGN. S.O. APR. 1979
TRAC. L.F. MAI 1979
KFR.
MAP 2
Forekomster og borhull 227 - 230 projisert i et plan.
Mineraliseringer med W+Mo >0,30% avmerket i borhullene.
Påviste mineraliseringer i gruver og skjerp avmerket.
Opplysninger fra:
BUGGE (1945), NYEGAARD (1975,1976)
PEDERSEN & al. (1974)
NNV —— SSÖ
Strosse krateret
Wolfram synken
BH 228
BH 229
BH 227
BH 230
3m 0,33% Mo 0,22% W
8m 0,14% Mo 0,21% W
3m 0,62% Mo 0,11% W
Schånnings-gruve
0,35% W 0,03% Mo
0,12% W
Stoll I
0,23% WO3?
700 m.o.h.
600 m.o.h.
500 m.o.h.
400 m.o.h.
300 m.o.h.
200 m.o.h.
100 m.o.h.

lithological mapping with the intension of obtaining a geological/mineralization model, which could form basis for continued investigations.

The main mineralized zone on the mountain plateau - including the three old mines - and the continuation of this zone down the valley wall were mapped in scale 1:1ooo (Map 2). Stoll 1 and 2 were mapped in scale 1:2oo (Map 3 to Map 6) and an interpretation of the geology of the Stoll 1 - Stoll 2 level was done in scale 1:1ooo (Map 7). Mapping was also done of the 12o m long adit to Strossekrateret (Map 8) and of the old adit Norges Bank 3o m above Schånningsgruben (Map 9).

The mapping of the valley wall was done by Sven Dahlgren, Jan Inge Tollefsrud and Per Erik Øverli, and the map of the area around Wolframsynken is taken from Nyegaard (1981).

The following description on geological setting and mineralization includes information from Urban (1971) and Nyegaard (1976).

Geological setting

The area around the Ørsdalen Mo-W mines comprises high grade metamorphic, mainly leucocratic gneisses. It is possible to discriminate between:

Quartz-feldspar gneiss or granulite which contains 1 to 2 % mafic minerals, mainly biotite. The rock is coarse grained and characteristically has developed platy quartz.

Biotite gneiss with 5-1o % mafic minerals, mainly biotite. It is a fine to medium grained, light grey rock with a vague foliation.

Biotite-hypersthene gneiss with or without garnet. The rock contains 2o-5o % mafic minerals and is characterized by the abundance of often isoclinally folded leucocratic veins.

Amphibolite. Most often it is a massive hornblende-plagioclase rock, but occasionally it is rich in cm-thick leucocratic bands.

Hornblende-biotite gneiss with lo-2o % mafic minerals. The rock is characterized by large kalifeldspar grains and a vague biotite foliation.

Quartz veins and pegmatites.

The mapped area (Map 2) is part of the eastern overturned flank of a large synclinal structure in the Ørsdalen area (Nyegaard, 1976). The transition zone from the the flank to the foldclosure of the synclinal structure occurs just south of Strossekrateret on the mountain plateau (Map 2) and in the bottom of Stoll 1 at the level of the valley floor (Map 7). The trend of this foldaxis is shown in the lengthprofile of the Ørsdalen deposit (Map lo).

Within the flank biotite gneiss and hornblende gneiss are the predominating rocktypes. The abundance of all other rocktypes is less than lo %. From Map 2 it is seen that the two rocktypes form drawn-out refolded isoclinal foldstructures, which obviously are structurally independent of the later synclinal structure. Such a complex deformational history explains why a minor but characteristic rocktype as garnet-biotite-hypersthene gneiss only is found as discrete lenses. It has not been possible to propose a structural model which could explain the distribution of these lenses. However, a certain macroscopic pattern can be recognized in the general distribution of the minor rocktypes. Amphibolite occurs near the foldclosure of the syncline, namely south of Strossekrateret (Nyegaard, 1976) and in Stoll 1 and 2 (Map 7), as garnet-biotite-hypersthene is found in the area above a line from Strossekrateret to the Outcrop at 6oo m (Map 2 and Map lo).

Mineralization

The ore-minerals in the Ørsdalen area are pyrrhotite, wolframite, scheelite, molybdenite, chalcopyrite and titanomagnetite plus a few rare minerals.

The main mineralized zone which approximately corresponds to the area mapped this year (Map 2) hosts all the major occurrences plus many showings (Nyegaard, 1981). Several types of mineralization can be recognized:

Disseminated pyrrhotite, molybdenite and chalcopyrite in the garnet-biotite-hypersthene gneiss. The grade is always very low.

Aggregates of wolframite rimmed by scheelite and/or molybdenite in subconcordant quartz veins enclosed in or close to garnet-biotite-hypersthene gneiss. Individual veins can be up to 2 m wide and lo m long but often several veins follows after each other. The mineralized lens comprising quartz veins and garnet-biotite-hypersthene gneiss is 3o to 6o m long. The grade seems to be o.5 to 1.o % MoS_2/WO_3 over a width of 1 to 5 m. Mineralized lenses of this type are known from Strossekrateret (Mo > W), Wolframsynken/strossen (W >> Mo), Schånningsgruben (W >> Mo), the outcrop at 6oo m (Mo ~ W) and the "cover" zone in DDH 228 and DDH 229 (Mo ~ W).

Flakes of molybdenite concentrated at the contact of often small subconcordant quartz veins in the various rocktypes. The overall grade is very low.

Scheelite mineralization in amphibolite. Scheelite is found as blebs in the amphibolite or is concentrated in mm-thick, leucocratic veins in the amphibolite. The overall grade is less than 1ooo ppm W. The type is found in Stoll 1 and Stoll 2 and within the foldclosure on the mountain plateau.

Scheelite in late jointzones. The type is found in the bottom of Stoll 1 (Map 5). The overall grade is very low.

Discussion/conclusion

The only mineralization type which holds a potential for an economic orebody is the large quartz veins associated with garnet-biotite-hypersthene gneiss. From the mapping it is known that this type forms discrete lenses. The actual size and geometry of the lenses are not known. From map lo it is seen that there is a geometric possibility, that the lens at Schånningsgruben can plunge 4o-9o^{o} S, and that the lens at Strossekrateret can continue in all directions, as these possibilities never have been tested by diamond drilling. However, it must be remarked that the most likely long-axis of a possible high-grade lens will be parallel with the foldaxis of the synclinal structure. The possibility that Wolframsynken/strossen continues at depth has been excluded by diamond drilling.

It is proposed to determine the size and geometry of the lenses at Schånningsgruben and Strossekrateret. If none of the high-grade lenses known today have a size comparable with say one half or one third of an economic orebody, it is very unlikely that hidden lenses should have such dimensions and the overall potential for finding sufficient ore is considerable lowered. It must be noted that the structural pattern previously described has diminished the rock volume of potential for high grade lenses, and the prospect of finding an economic orebody - o,5 to 1,o mill tons with o,5 to 1,o % MoS_2/WO_3 - is not to good.

Recommendation

If investigations are to continue in the Ørsdalen area, it is recommended to investigate the possible continuation at depth of Schånningsgruben and Strossekrateret by diamond drilling.

Proposal for diamond drilling.

Position and direction of proposed diamond drill-holes are given in Map 11 and Map 12. If the drillhole at Schånningsgruben is positive, it is proposed to drill additional holes with intersection north and south of the first intersection at the same level. Similar at Strossekrateret a positive result in the first hole may lead to a change of the proposed drill pattern.

GURSLI

Location

The old Gursli molybdenum mine is situated 16 km NW of Flekkefjord in SW-Norway at the north shore of lake Gullvatn (Map 1).

Previous work

The mine was worked from 1915 to 1919 and again for a short period in 1925. Showings with molybdenite form a 1 km wide zone which extends 3 km in NNW-SSE direction, but mining was nearly exclusively restricted to the Gursli mine (Map 13). Here mining took place from the lake level 314 m.a.s. and up to 37o m.a.s. A total of 38.ooo tons of ore was produced and yielded 67,6 tons of concentrate with an estimated MoS_2-content of 7o %. Assuming a recovery of 8o % the average mill head grade for the entire period has been o,16 % MoS_2.

Since the mining period no major investigations have been done in the area. Elkem/Hafslund undertook an unsystematic blast-hole sampling to access the overall grade of the area in the sixties, and Folldal Verk A/S has done geological mapping of the area in scale 1:15ooo and of the major mining levels in scale 1:5oo in 1973 (Pedersen, 1975).

Geological setting

The zone of molybdenite mineralization is situated within the metamorphic terrain close to the intrusive Egernsund anorthositic complex. The metamorphic rocks comprise quartz-feldspar gneiss with platy quartz and less than 5 % mafic minerals, and various mafic rocktypes as hypersthene-bearing amphibolite, biotite gneiss, hypersthene-biotite gneiss and garnet-hypersthene-biotite gneiss. The mafic rocktypes all form horizons up to 2o m wide in the quartz-feldspar gneiss (Map 13).

In the area with molybdenite mineralization the mafic rocktypes make up 2o % of the volume, and they outline an isoclinal fold (Map 13). It is an overturned fold. The axial plane strikes N-S and is dipping 75^{o}W. The fold is open towards south and the fold-axis dips 4o^{o}S. Flexures on the axial plane are formed by later open folding.

Anorthosite intruded the area at a late stage of the deformational history. A major anorthosite body occurs 1 km east of the Gursli field, and in addition several minor anorthosite bodies have intruded the axial zone of the isoclinal fold by stoping (Map 13). It is assumed that these minor bodies are part of a large anorthosite body at depth.

Mineralization

In the Gursli ore field three types of mineralization can be recognized.

The first type is molybdenite disseminated in garnet-hypersthene-biotite gneiss. The type is frequent in the Gursli area and may represent a primary stratabound mineralization. The MoS_2 -content is always very low.

The second type is molybdenite in quartz-feldspar veins and on joint-planes, often near or in continuation of quartz veins. The width of the veins varies from a few cm to a couple of metres and they can be up to 4o m long. The veins are subconcordant and deviate only slightly (1o^{o}) from the foliation. The largest veins are found in the northern part of the Gursli mine in the hinge zone of the open folding (Map 14), and are enclosed in garnet-hypersthene-biotite gneiss. Narrow veins can contain up to 1 % MoS_2, but over a mining width the grade is o,1 to o,2 % MoS_2. In addition to molybdenite the veins also contain minor chalcopyrite and pyrite with traces of sphalerite, Bi-minerals and gold.

The third type is molybdenite disseminated in anorthosite. The type is found in the southern part of the Gursli mine, where an anorthosite body 35 m long and 8 m wide has intruded garnet-hypersthene-biotite gneiss to a level of 1o-15 m above the lake surface of Gullvatn. The mineralization intensity seems to be very irregular. The entire volume of anorthosite above the lake level has been mined out (c. 7ooo tons). In 1925 2ooo tons of remaining ore was mined in this area containing o,3 % MoS_2. In addition to disseminated molybdenite the anorthosite also contains minor amounts of titanomagnetite, chalcopyrite and pentlandite-bearing pyrrhotite.

It is proposed that the mineralization in garnet-hypersthene-biotite gneiss represents the original type of mineralization, that quartz-feldspar veins represent mobilization during metamorphism and that the molybdenite in anorthosite originates from garnet-hypersthene-biotite gneiss assimilated during the intrusion of the anorthosite. A process of concentration must have existed to form the high grade mineralization.

It is assumed that the outcropping plugs of anorthosite at depth merges in a single large body. The folding pattern implies that the garnet-hypersthene-biotite gneiss must have existed at depth below lake Gullvatn. This opens the possibility for a large volume of mineralized anorthosite at deeper levels in the Gursli mine and further south below lake Gullvatn. Such an orebody could be outcropping at the bottom of the lake (Map 14).

Investigations in 1982

The mineralized anorthosite is assumed the only worth-while exploration target. From old reports it is known that in 1925 a 12 m shaft 15 m west of the anorthosite body with a 25 m long crosscut at the bottom of the shaft was mined to investigate the anorthosite. In the reports it was mentioned that ore was found at both ends of the crosscut.

It was decided to empty the old workings for water and map and sample the mineralized anorthosite. Because of inflowing water (at least lo m^3/h) it could not be done. This is in accordance with a rumor among the local people that the mining was stopped due to water problem, and explains why the high grade mineralized anorthosite has not been mined out.

Two rocksamples from the Gursli area have been analyzed (Table 2). The anorthosite rich in molybdenite contains 1.7 % Mo, 28o ppm Cu, less than 2 ppm Ag and less than o,1 ppm Au.

Recommendation

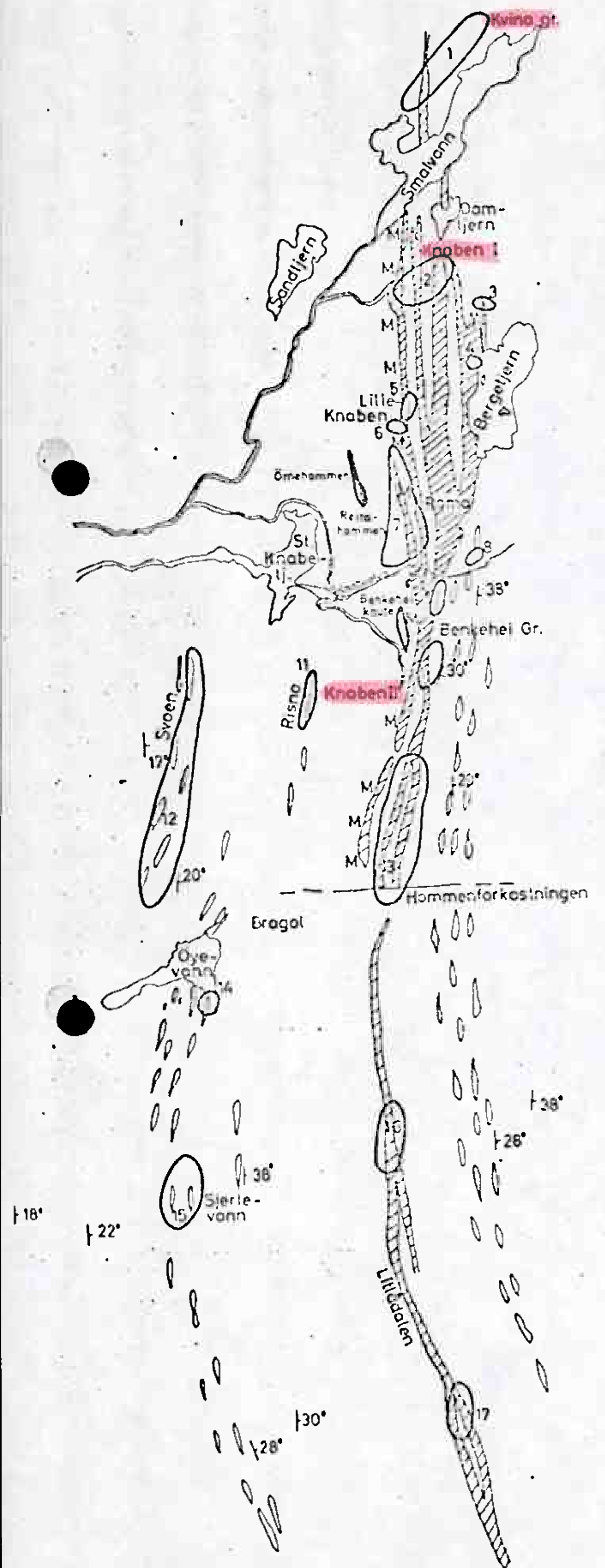
It is proposed to diamond drill the continuation at depth of the mineralized anorthosite. The target of the drilling program is to establish a possible orereserve of o,5 mill tons. If all 5 holes are drilled the prospect must be evaluated before continued drilling. Before starting drilling it is proposed to determine the bottom contours of lake Gullvatn.

Proposal for a drilling program

The drillsites and the directions of the proposed drillholes are given in Map 14. If the first 3 holes are negative, it is propo-sed to cancel the remaining program.

Locality	Rock description	Mo (ppm)	Cu (ppm)	Ag (ppm)	Au (ppm)
Knaben II	Gangfjell with MoS_2-bearing quartz vein	1.2 %	260	< 2	< 0.1
300 m E of Knaben II	Semi-massive sulphides in biotite-rich rock	380	1.7 %	14	< 0.1
Reinshommen	Quartz vein with disseminated chalcopyrite and molybdenite	1200	5300	8	< 0.1
Knaben I	Glimmerite with c. 10 % disseminated molybdenite	13.7 %	320	< 2	< 0.1
Kvina	Glimmerite and quartz vein rich in molybdenite	19.6 %	360	< 2	< 0.1
Kvina	Quartz-hornblende vein with disseminated MoS_2 and $CuFeS_2$	1000	1700	< 2	< 0.1
Cu-skjerp east of Smalvatn	Semi-massive sulphides in quartz-feldspar rock	380	3.0 %	65	< 0.1
Gursli	Anorthosite with disseminated molybdenite	1.7 %	280	< 2	< 0.1
Gursli, Mysse-skjerpene	Semi-massive sulphides in feldspar rock	5500	2200	< 2	< 0.1

Table 2 Analyses of rocksamples from the Knaben and Gursli areas.



Tegnforklaring:

Fahlbånd

Spredte kisbånd og aplittganger

Aplittlinser i malmsonen M

Spesielt undersøkte områder — Ross et al. 1973

Oversikt over diamantboring

Område	Antall hull	Lengde
1. Kvina	3	400,50m
2. Knaben I	6	553,75m
3 Bergetjern	1	510,43m
4. Bergetjern	1	392,05m
5. Lille Knaben	10	577,88m
6. Vestre Reinshommen	3	411,44m
7. Reinshommen	5	439,21m
8. Vannmagasin	1	295,00m
9. Benkehei	5	1181,81m
10. Knaben II	7	531,00m
11. Risna	4	240,69m
12. Beritshei	9	641,58m
13. Hommen	37	8150,20m
14. Öyevann	1	99,34m
15. Sjerlevann	6	424,32m
16. Lillådalen	3	475,39m
17. Björnehommen	2	303,77m
Sum	104	15628,46m

MAP 3

Kart over Knabeheiene molybdenfelt KVINESDAL, VEST-AGDER	MÅLESTOKK 1 : 30 000	MÅLT TEGN. TRAC. KFR.

KNABEN

Previous work

The Knaben area is the oldest and largest molybdenum mining district in Norway (Map 1). From 1885 to 1972 the district produced 18.8oo tons of MoS_2 from 8,8 mill tons of ore.

A detailed account on the geology and mineralization in the Knaben district is presented in Bugge (1963). The mine-geologist from 197o to 1973 summarized the prospection and explotation work undertaken in the district prior to the closure of the mine (Gustavsen, 1973). He also prepared a detailed geological/ mineralization map in scale 1:5ooo of the Knaben area. From 1979 to 1981 Sydvaranger A/S did extensive exploration in the area (Gvein & Rui, 198o and Gvein, 1981).

Activities

During 1982 the joint venture Norske Fina A/S - Folldal Verk A/S rented the claims in the area from the government. The tailing from the Knaben II mine was sampled, and at the same time the old mines and major showings in the area were visited. The above mentioned investigations and descriptions of the area were studied and compared with own fieldobservations.

Geological setting

In the Knaben district it is possible to discriminate between various rocktypes.

The most frequent rocktype is from old time called red granite. Actually it is an orthogneiss. It is a massive, pink, coarse-grained rock with a vague foliation and granitic composition. The foliation is due to elongated kalifeldspar grains, platy quartz and a minor content of biotite.

The other important rocktype is the grey gneisses. They are found as concordant layers and lenses in the red granite. Three varities of the grey gneisses can be discriminated. A light grey, finegrained, well foliated or banded biotite-hornblende gneiss often with a minor content of iron-sulphides. Along strike the biotite-hornblende gneiss is transitional into augengneiss, which is a grey, coarsegrained, vaguely foliated gneiss with characteristic large blastoporphyres of kalifeldspar. The augengneiss also contains a minor amount of biotite and iron-sulphides. Associated with the leucocratic gneisses it is frequent to find concordant lenses or bands of amphibolite.

A rare rocktype is discordant amphibolites which are migmatized and contain folded quartz-feldspar mobilizations. Such an amphibolite can be followed from just north of the open pit at Knaben II and towards SE (Map 15). A hornblende foliation in the amphibolite is oriented lo-2o^{o} SSE.

In connection with the mineralizing episode the above mentioned rocktypes were altered and quartz veins were formed. These newformed rocks shall be described below.

Various post-tectonic rocks also occur in the area. Their agerelation to the mineralizing episode is not well understood. They comprise coarsegrained, discordant, subvertical pegmatites and finegrained, discordant aplites.

The youngest geological episode is the intrusion of E-W striking subvertical dolerites up to lo m thick and several km long.

The red granite predominates in the Knaben area. The grey gneisses are mainly found within a loo to 3oo m thick horizon which also contains many thin layers and lenses of red granite (Map 15 and Map 16). A distinct marker layer has not been mapped out and therefore the detailed structure of the gneiss horizon is not well known.It was mentioned above that the augengneiss is transitional into biotite-hornblende gneiss. It is characteristic that the augengneiss predominates in the area from Knaben II to Kvina, as the biotite-hornblende gneiss mainly is found in the area south of Knaben II. The grey gneisses are also found as scattered layers and lenses enclosed in the red granite, and especially in the area below the main gneiss horizon.

The general strike of the gneiss is N-S with deviations of up to 3o degree. The dip is 2o-5o^{o} E. Isoclinal folding and minor dragfolding have been observed a few places. The small variation in strike/dip of the gneiss is due to open folding. The orientation of the gneiss foliation are plotted in Fig. 1 to Fig. 4. It is possible to recognize two foldaxes. One dipping 25^{o} to 3o^{o} SE and one dipping c. lo^{o} S. Individual open folding structures have been measured at Ørnehommen and Knaben I and on the structural map of Knaben II (Map 17). The measurements (Fig 5) define all the approximate same foldaxis, which dips c. 35^{o} SE. The lo^{o} S dipping axis has not been identified in individual foldstructures, but it is identical with the plunge of the orebodies at Knaben II and Kvina (see below).

Mineralization, types

The most frequent oreminerals in the Knaben area are molybdenite, chalcopyrite, pyrrhotite and pyrite. Several types of mineralization can be recognized.

Disseminated MoS_2 in various altered rocktypes is the most important type. The most frequent type is the socalled gangfjell. It is a bleached red granite enriched in quartz. The bleaching is caused by the break-down of the feldspar with seritization in the core of the grains and albite formation at the rim. The enlarged quartz content is mainly found in diffuse quartz veinlets. Molybdenite is found disseminated in the gangfjell often associated with the quartz. In addition to MoS_2 the gangfjell also contains 2oo to 4oo ppm Cu in the form of chalcopyrite. The upper part of the Knaben II orebody was gangfjell, and o,5 to

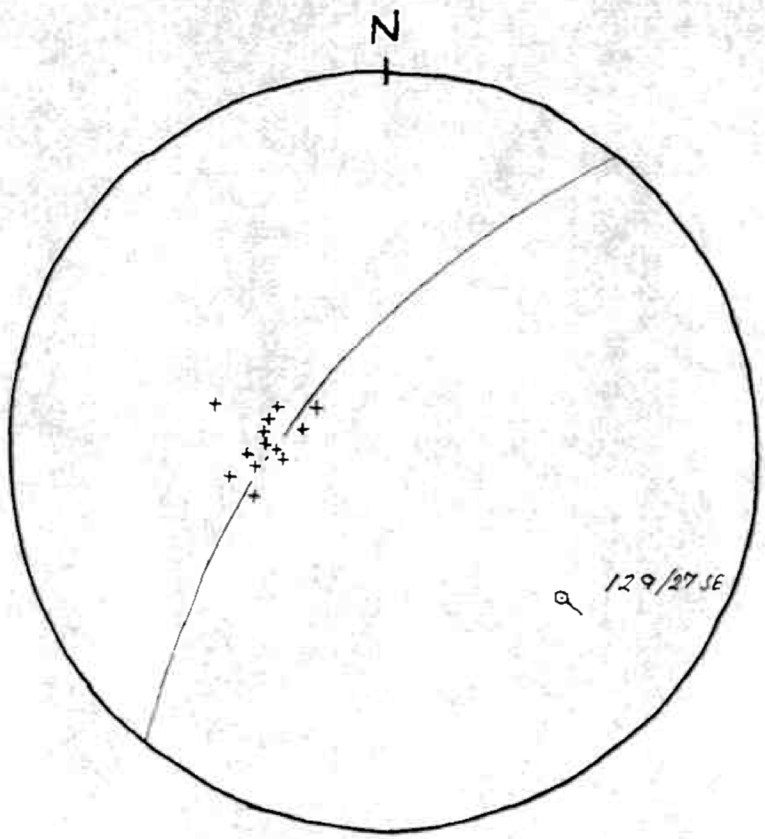


Fig. 1 Foliation measurements and constructed foldaxis from the area south of Knaben II to Reinshommen.

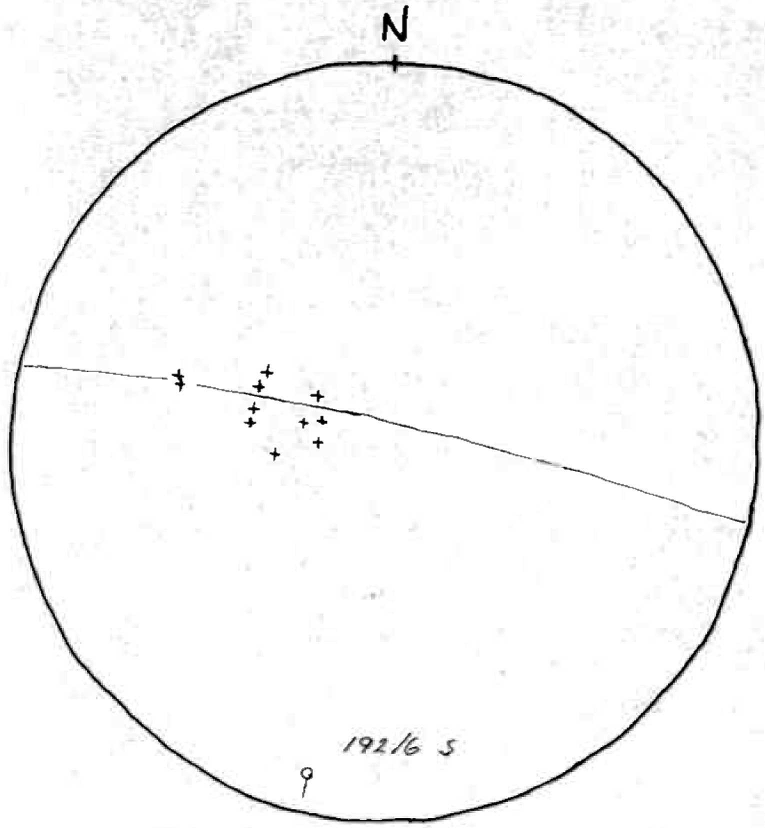


Fig. 2 Foliation measurements and constructed foldaxis from the area between Reinshommen and Knaben I.

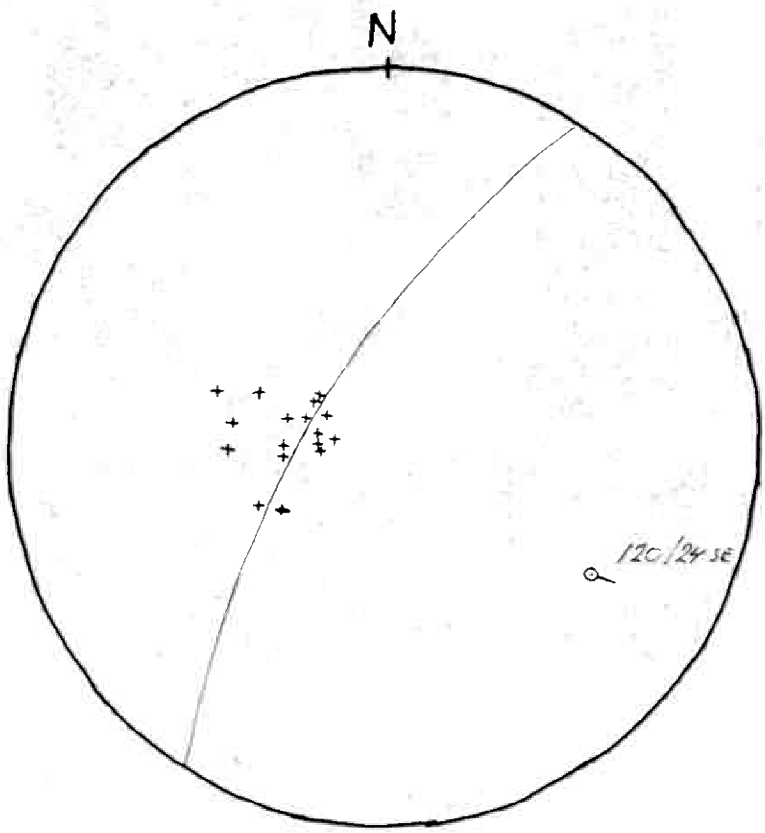


Fig. 3 Foliation measurements and constructed foldaxis from the area between Knaben I and Smalvatn.

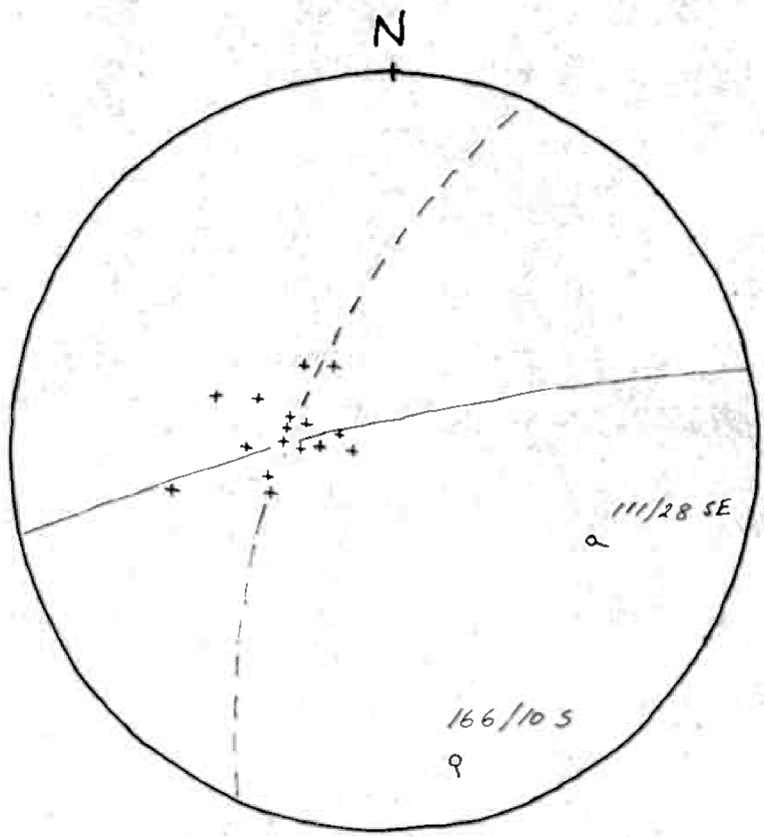


Fig. 4 Foliation measurements and constructed foldaxes from the area around Kvina.

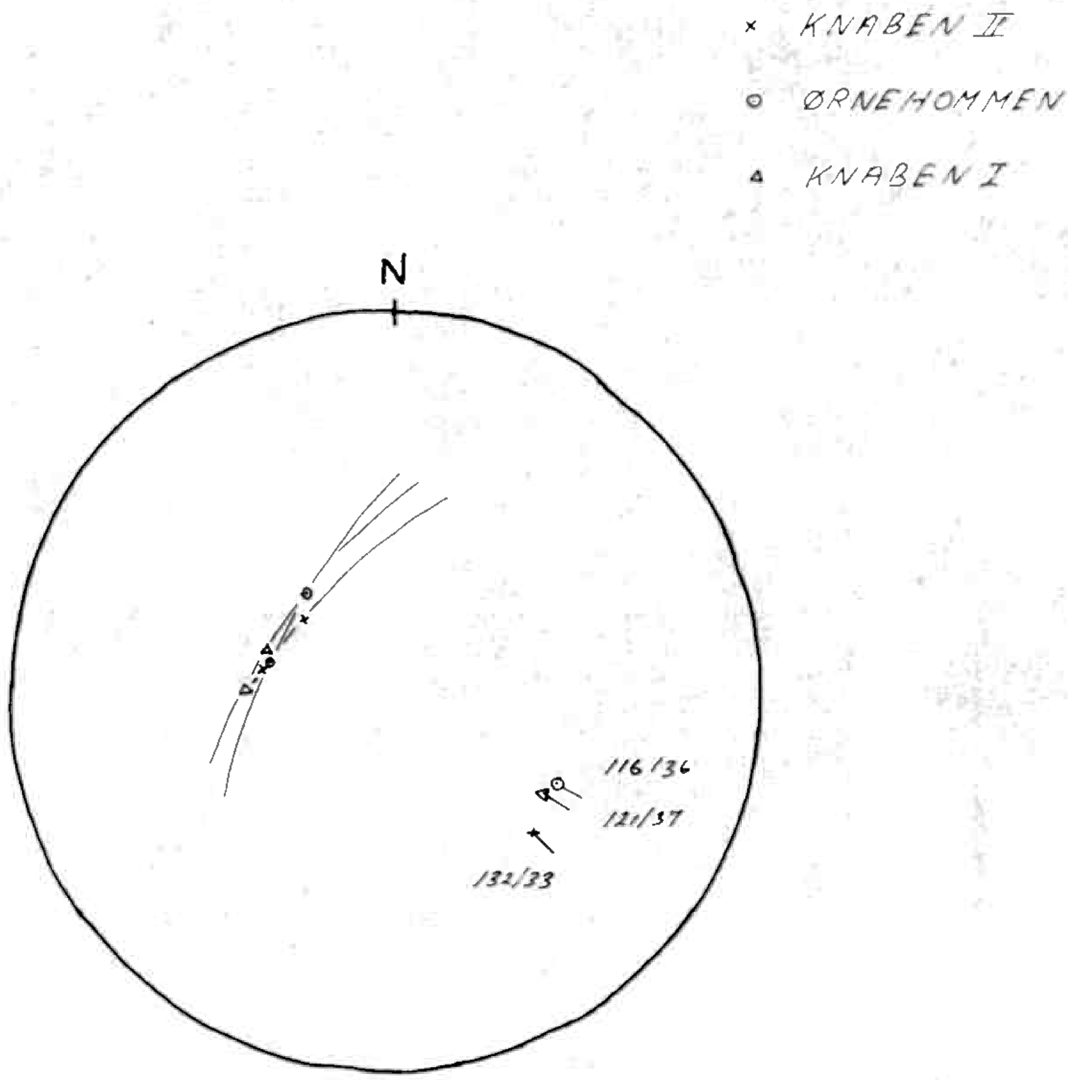


Fig. 5 Orientation of the flanks of the ore controlling fold structures at Knaben I and II and Ørnehommen. The foldaxes are constructed.

1,o mill tons contained o,3 to o.5 % MoS_2. It must be noted that large volumes of gangfjell contains no molybdenite. Where amphibolite has underwent alteration there is formed a massive glimmerite. At Knaben I glimmerite is formed at the bottom of a folded amphibolite, and it is impregnated with MoS_2 (Table 2).

Mineralized quartz veins represent an other important type of mineralization. Two variations can be discriminated. The first is thin (less than o,5 m thick), concordant quartz veins which occur enclosed in gangfjell, glimmerite, red granite and in the grey gneisses. Molybdenite and traces of chalcopyrite is concentrated at the contact of the veins. Swarms of quartz veins in gangfjell make up the low grade mineralization in the lower part of the Knaben II orebody. The other type of quartz vein comprises the metre-thick veins at Kvina, upper Reinshommen and possible also Knaben I. In addition to quartz the veins also contain feldspar, hornblende and biotite. Molybdenite and chalcopyrite are found disseminated in the veins. The Mo/Cu ratio is 2 to 3 times less than in the gangfjell, but still above 1.

A third type of mineralization,comprising semi-massive sulphides is found above the Knaben II orebody within the gneiss horizon, and above the Kvina orebody also within the gneiss horizon. Semi-massive sulphide accumulations are found in concordant and discordant veins of brecciated hostrock. Individual veins are up to o,5 m thick. Pyrrhotite predominates with minor amounts of chalcopyrite, pyrite and molybdenite. The Mo/Cu ratio is less than 1, and characteristic this type also contains minor amounts of silver (Table 2).

The grey gneisses with a low content of iron-sulphides and occasionally also traces of molybdenite and chalcopyrite represent a fourth type of mineralization.

Mineralization, description of localities

Mining has taken place from a few large mines and many small mines and showings. The most important ones are described below.

Knaben II is the largest mine (Map 15). From 1918 to 1972 it has produced 18.ooo tons of MoS_2 from 8,6 mill tons of ore. The orebody is rulerformed with a length of more than 13oo m, a width of up to 4oo m and a thickness of up to 4o m. The orebody is situated within the red granite below the gneiss horizon. The oreplane is concordant with the structure of the gneisses and forms an open anticlinal structure (Map 17). The long axis is dipping lo-15^o S. There is a pronounced zonation within the orebody with molybdenite-bearing quartz veins in gangfjell in the lower part and disseminated molybdenite in gangfjell in the upper part. The later with higher grades than the first.The Knaben II orebody is well-investigated with diamond drilling, and it is estimated that there remains 5 mill tons of ore with o,15 % MoS_2 in the lower part of the orebody.

The Kvina orebody was mined from 19o8 to 1955. The production totalled 23o tons of MoS_2 from loo.ooo tons of ore. As with Knaben II the Kvina orebody is rulerformed. The maximum dimensions are 24o m x 8o m x 16 m. The orebody occurs enclosed in red granite below the main gneiss horizon. The oreplane (22^o/3o^{o}E) is concordant with the structure of the red granite, and the long axis is dipping c. lo^{o}S. Molybdenite and chalcopyrite are found at the contact of and disseminated in metre-thick quartz veins and pegmatites. The continuation at south has never been diamond drilled. There is drilled one hole 15o m east of the Kvina orebody, and it does not show any mineralization.

Knaben I is the oldest mine in the area. From 1885 to 1939 it produced 57o tons of MoS_2 from 8o.ooo tons of ore. Knaben I is situated in the lower part of the gneiss horizon (Map 16). The orebody is found below a syncline in amphibolite. The flanks are oriented $18^{\circ}/37^{\circ}$ E and $18o^{\circ}/41^{\circ}$ E. The foldaxis of the structure is dipping 37°SE. The orebody is only loo m long and has been followed 25 m below the surface, which corresponds to a down-dip length of 45 m. Molybdenite is found disseminated in glimmerite and associated with quartz veins. The extend of underground exploration is not known. Relevant diamond drilling from the surface comprises one hole (4.1). There is not reported any mineralization in this hole, and it may be placed to far to the south to catch up a possible continuation of the ore in the direction of the foldaxis.

Ørnehommen mine produced 4,2 tons MoS_2 from 2ooo tons of ore. The deposit is situated below a syncline in biotite-gneiss enclosed in red granite and well below the main gneiss horizon. The flanks are oriented $14^{\circ}/36^{\circ}$ E and $5o^{\circ}/38^{\circ}$ SE. The mineralization type is quartz veins in gangfjell.

For description of the many smaller mines and showings, see Bugge (1963).

Discussion/conclusion

The formation of altered rocks, the formation of quartz veins and sulphide accumulations and the occurrence of a zonarity pattern with the variation in the Mo/Cu ratio and the distribution of silver values point to the existence of migrating hydrothermal solutions in the area during the mineralizing episode.

The structure of the gneiss controlled the distribution of the hydrothermal solutions. Anticlines and synclines formed during open folding have acted as sites for alteration and precipitation of quartz and the oreminerals.

Knaben II is formed within an anticlinal structure (Map 17), and this obvious facilitated the formation of a very elongated and large orebody. The only other orebody with an elongated geometry is the Kvina deposit. It is proposed that the zonarity seen in Knaben II is the result of cooling of Mo-bearing hydrothermal solutions migrating upwards along the axis of orebody. It is further proposed, that the oretype at Kvina represents formation at an even lower temperature. This opens the possibility, that an orebody of a Knaben II model may be found south of Kvina (Map 18). It is interesting to see, that the only drillhole in the area (D 1) has lo to 15 m with traces of molybdenite at the expected depth (Gvein & Rui, 198o).

Knaben I and Ørnehommen are found below synclinal structures. They seem not to have the same elongated geometry, but characteristically these deposits seem to have a higher grade than the type in anticlinal structures.

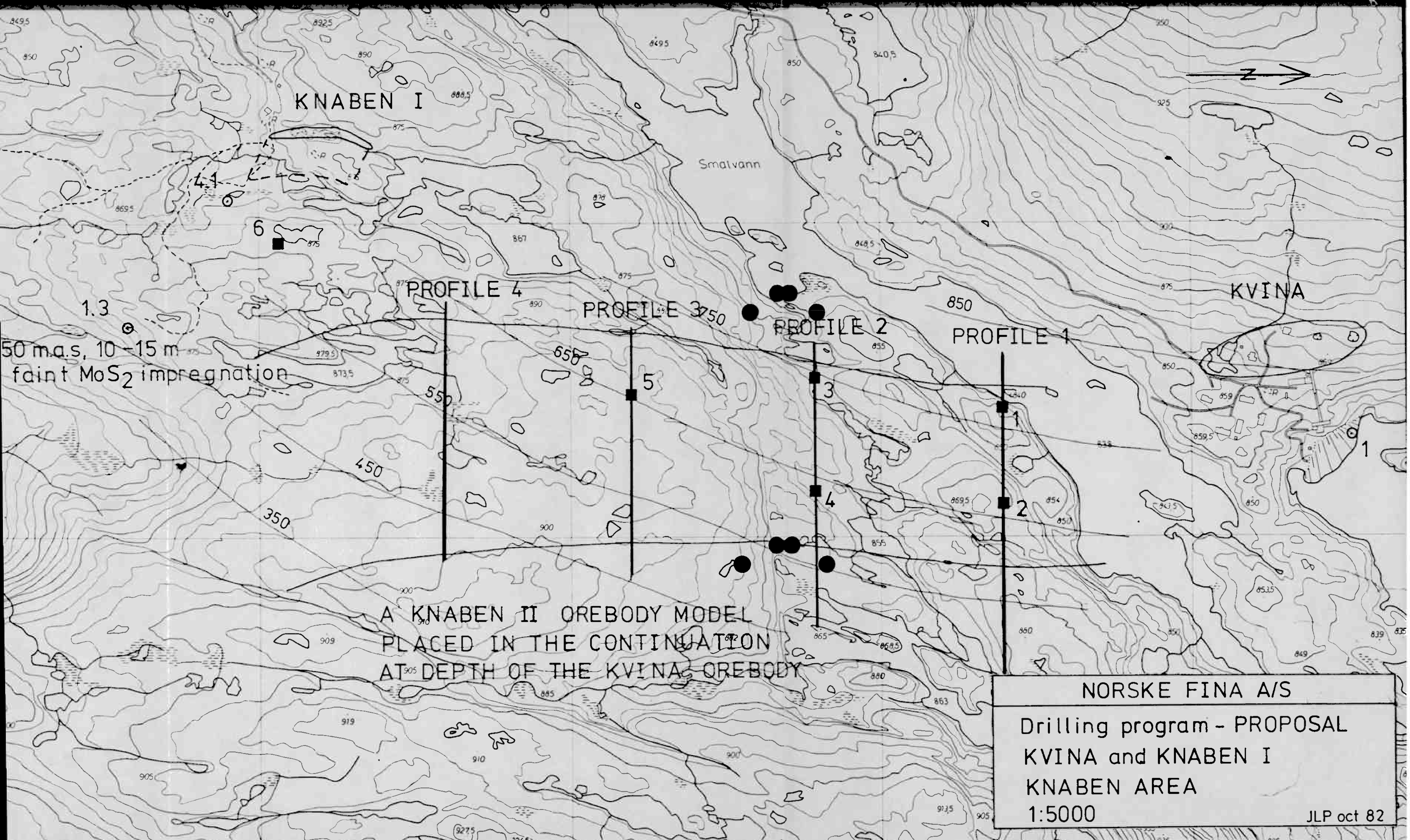
It shall bee noted that the total amount of molybdenite per metre in the Kvina/Knaben I area equals the amount in the Knaben II area, namely 5o-1oo tons MoS_2/metre. Therefore, in the Kvina/ Knaben I area it is only a question of finding a structure which was able to concentrate the molybdenite. Such a structure could very well exist at depth in the continuation of the Kvina orebody.

Recommendation

It is proposed to diamond drill the continuation towards south of the Kvina orebody (Map 18) with the target of finding a Knaben II model orebody.

Further, it is recommended to drill a single hole east of the Knaben I orebody with the target of finding a Knaben I similar orebody on a deeper level (Map 18).

In connection with the diamond drilling it is recommended to do a detailed geological/mineralization map in scale 1:1ooo of the Kvina-Knaben I area with the purpose of identifying open folding structures in the gneiss horizon.



KNABEN I
Smalvann
KVINA
PROFILE 4
PROFILE 3
PROFILE 2
PROFILE 1
1.3
50 m.a.s, 10 -15 m
faint MoS2 impregnation
6
4.1
5
3
4
1
2
1
750
650
550
450
350
850
A KNABEN II OREBODY MODEL
PLACED IN THE CONTINUATION
AT DEPTH OF THE KVINA OREBODY
NORSKE FINA A/S
Drilling program - PROPOSAL
KVINA and KNABEN I
KNABEN AREA
1:5000
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Proposal for a drilling program

The proposed diamond drilling program is outlined in Map 18 and in Table 3.

If high grade mineralization is found in any of the holes, and seems to comply with the proposed model (the depth is not necessary the proposed one), it is advocated to drill 3o m after this intersection. Hole no. 1 shall in all cases be drilled to 2oo m. In case high grade mineralization is found in any of the first holes of no. 1 to 5 it is still recommended to continue the drilling program as planned. Any drill metres in surplus shall be used for additional holes in profile 3 and/or for holes in profile 4. Before beginning any fill-in drilling the prospect must be evaluated on basis of the obtained information. If hole no. 6 is positive, and there is drillmetres in surplus it is proposed to drill additional holes in a grid of 5o x 5o m in the surrounding area.

Locality	Profile	Hole no.	Dip	Altitude at beginning of the hole	Altitude of expected intersection	Length of hole to expected intersection	Length of hole if no mineralization is meet
Kvina	1	1	90°	840 m asl	760 m asl	80 m	200 m
Kvina	1	2	90°	870	660	210 m	260 m
Kvina	2	3	90°	850	750	100 m	200 m
Kvina	2	4	90°	860	620	240 m	280 m
Kvina	3	5	90°	890	650	230 m	280 m
Knaben I	-	6	90°			140 m	200 m
							1420 m

Table 3 Proposal for a diamond drilling program in the Kvina - Knaben I area.

For position of the drillholes, see Map 18.

THE TAILING AT KNABEN II

Introduction

During the mining period at Knaben II (1918 - 1972) a total of 8,6 mill tons of ore with o,21 % MoS_2 (o,13 % Mo) was mined and milled. The tailing was in the entire period discharged at the east end of Lille Knabetjern. First Lille Knabetjern was filled and later also most of Store Knabetjern (Map 19). The tailing contains minor amounts of Mo and Cu in the form of molybdenite and chalcopyrite.The Mo-content depends on the mill-head grade and the recovery. The recovery has increased from perhaps 7o-8o % during the first years of operation with high grade ore (o,3 % MoS_2) and up to 9o % at the time when the mine was closed. The expected content would then vary from 8oo to 15o ppm MoS_2. The Cu-content corresponds to the original content of Cu in the ore, and it is 2oo to 4oo ppm.

The background idea for sampling the tailing was twofold:

- To identify tailing deposited during the first years of operation with the expected high Mo-content.
- To identify areas with heavy mineral enrichment where molybdenite and chalcopyrite would be concentrated.

Activities

The sampling program was limited to the Lille Knabetjern bassin. Two profiles approximate 2oo m apart and both parallel with the assumed flow direction was sampled. On each profile, holes - 5o m apart - were sampled for each metre (Map 19 and Map 2o). The sampling was done with a 1 m iron-tube (Fig 6), which mounted with rods was hammered down in the sand 1 m at a time (Fig 7). A total of 252 samples were collected from 21 holes (Table 4). In most holes it was possible to reach the bottom of the tailing pond. Each sampled weighed c. 1 kg. It was blended and c. 2oo g was sent for Mo-analysis (Table 5). One heavy-mineral sample

Fig. 6 The 1 m long iron-tube used for sampling the tailing

Fig. 7 Sampling of the tailing.

Drillhole	Length	Sample numbers	Terminated in:	Remarks
PROFILE 1	Totally 117 samples			
o	4.4 m	1 - 5	Peat	
25	1o.6	1 - 11	Peat	Started 1.5 m below surface of tailing
75	17.7	1 - 18	Peat/stone	
125	16.o	1 - 16	Stone	
175	16.o	1 - 16	Soil	
225	18.o	1 - 18	Sand	Not drilled through ?
275	15.9	1 - 16	Soil	
325	1o.5	1 - 11	?	
375	5.9	1 - 6	Peat	
PROFILE 2 .	Totally 131 samples			
o	4.5	1 - 5	Peat	
5o	13.o	1 - 13	Soil	
1oo	2o.2	1 - 2o	Sand	
15o	15.3	1 - 16	Peat/sand	
2oo	16.6	1 - 17	Soil	
25o	11.8	1 - 12	Stone	
3oo	6.8	1 - 7	Peat	
35o	8.3	1 - 9	Peat	
4oo	11.7	1 - 12	Peat/sand	
45o	1o.5	1 - 11	Peat	
5oo	8.9	1 - 9	Peat	
Hole A , at the NW-corner of the football field. Totally 4 samples				
-	3.9	1 - 4	Peat	

Table 4 Sample list from the sampling of the tailing

PROFILE 1

Sample	No.	Mo ppm
1-0	1	140
	2	170
	3	90
	4	180
	5	200
1-25	1	95
	2	100
	3	210
	4	480
	5	460
	6	420
	7	1100
	8	520
	9	480
	10	330
	11	480
1-75	1	45
	2	50
	3	140
	4	250
	5	370
	6	280
	7	400
	8	310
	9	290
	10	250
	11	120
	12	70
	13	240
	14	310
	15	110
	16	80
	17	80
	18	110
1-125	1	230
	2	150
	3	70
	4	130
	5	170
	6	230
	7	150
	8	130
	9	140
	10	190
	11	130
	12	120
	13	80
	14	100
	15	80
	16	100

Sample	No.	Mo ppm
1-175	1	80
	2	50
	3	80
	4	130
	5	140
	6	260
	7	170
	8	130
	9	230
	10	160
	11	180
	12	160
	13	100
	14	230
	15	320
	16	360
1-225	1	80
	2	50
	3	60
	4	90
	5	160
	6	160
	7	120
	8	120
	9	130
	10	160
	11	180
	12	160
	13	170
	14	130
	15	130
	16	90
	17	130
	18	160
1-275	1	80
	2	40
	3	90
	4	70
	5	120
	6	100
	7	140
	8	100
	9	160
	10	280
	11	230
	12	160
	13	150
	14	130
	15	190
	16	140

Sample	No.	Mo ppm
1-325	1	50
	2	80
	3	60
	4	80
	5	60
	6	60
	7	80
	8	150
	9	90
	10	70
	11	80
1-375	1	40
	2	70
	3	90
	4	60
	5	50
	6	110
Hole A	1	45
	2	40
	3	18
	4	160

Table 5 Analyses of the Mo-content in sand samples from the tailing at the Knaben II mine.

PROFILE 2

Sample no		Mo (ppm)
2-0	1	160
	2	80
	3	170
	4	190
	5	150
2-50	1	100
	2	350
	3	380
	4	240
	5	480
	6	560
	7	760
	8	390
	9	450
	10	470
	11	400
	12	710
	13	400
2-100	1	210
	2	480
	3	430
	4	180
	5	430
	6	290
	7	160
	8	150
	9	220
	10	290
	11	170
	12	140
	13	130
	14	90
	15	110
	16	140
	17	160
	18	180
	19	170
	20	160

Sample No.		Mo ppm
2-150	1	130
	2	300
	3	250
	4	140
	5	380
	6	200
	7	250
	8	270
	9	220
	10	240
	11	220
	12	160
	13	170
	14	100
	15	130
	16	80
2-200	1	130
	2	200
	3	130
	4	100
	5	420
	6	250
	7	170
	8	240
	9	190
	10	240
	11	130
	12	140
	13	150
	14	150
	15	120
	16	140
	17	210
2-250	1	180
	2	140
	3	80
	4	140
	5	300
	6	140
	7	220
	8	170
	9	180
	10	240
	11	170
	12	160

Sample No		Mo ppm
2-300	1	80
	2	130
	3	90
	4	90
	5	130
	6	130
	7	140
2-350	1	130
	2	60
	3	70
	4	80
	5	130
	6	130
	7	130
	8	160
	9	230
2-400	1	150
	2	60
	3	70
	4	100
	5	90
	6	130
	7	100
	8	160
	9	240
	10	270
	11	290
	12	190
2-450	1	190
	2	40
	3	80
	4	90
	5	90
	6	90
	7	90
	8	400
	9	270
	10	300
	11	220
2-500	1	50
	2	90
	3	160
	4	130
	5	110
	6	220
	7	300
	8	280
	9	120

Table 5 Continued

has been panned from the tailing and analysed for various elements (Table 6).

Results

The Lille Knabetjern bassin contains c. 3,o mill tons of sand. The distribution of Molybdenum is shown in Map 2o and Fig 8. The aritmetric average MoS_2 content is o,o3o % MoS_2. A higher grade lens with o,o62 % MoS_2 occurs from 25 m to 125/225 m from the discharge point. The size of the lens is estimated to be o,5 mill tons. The Cu-content is one half of the Mo-content (Table 6). This is in accordance with the expected content. Even in concentrates with c. 1 % Cu no Ag and Au are detected.

Conclusion/recommendation

It has been demonstrated that a lens with heavy mineral enrichment exists within the tailing. The grade and tonnage of this lens is to low to be of any economic potential. No further work is recommended.

Spectrographic analysis:

Fe, Si, Al and Ti	are in the range	o,5 %	to	5 %
Mn, Ca and Na	are in the range	o,o5 %	to	o,5 %
Cr, Pb, V abd Ni	are in the range	5o ppm	to	5oo ppm
Co	is in the range	5 ppm	to	5o ppm
Mo	is approximately	2 %		
Cu	is approximately	1 %		

Analysis by atomic absorbtion:

Se	2o	ppm
Te	< 1	ppm
Au	< o,1	ppm
Ag	< 1	ppm

Table 6 Analysis of heavy-mineral concentrate panned from the tailing. The factor of enrichment is approximately 25o times.

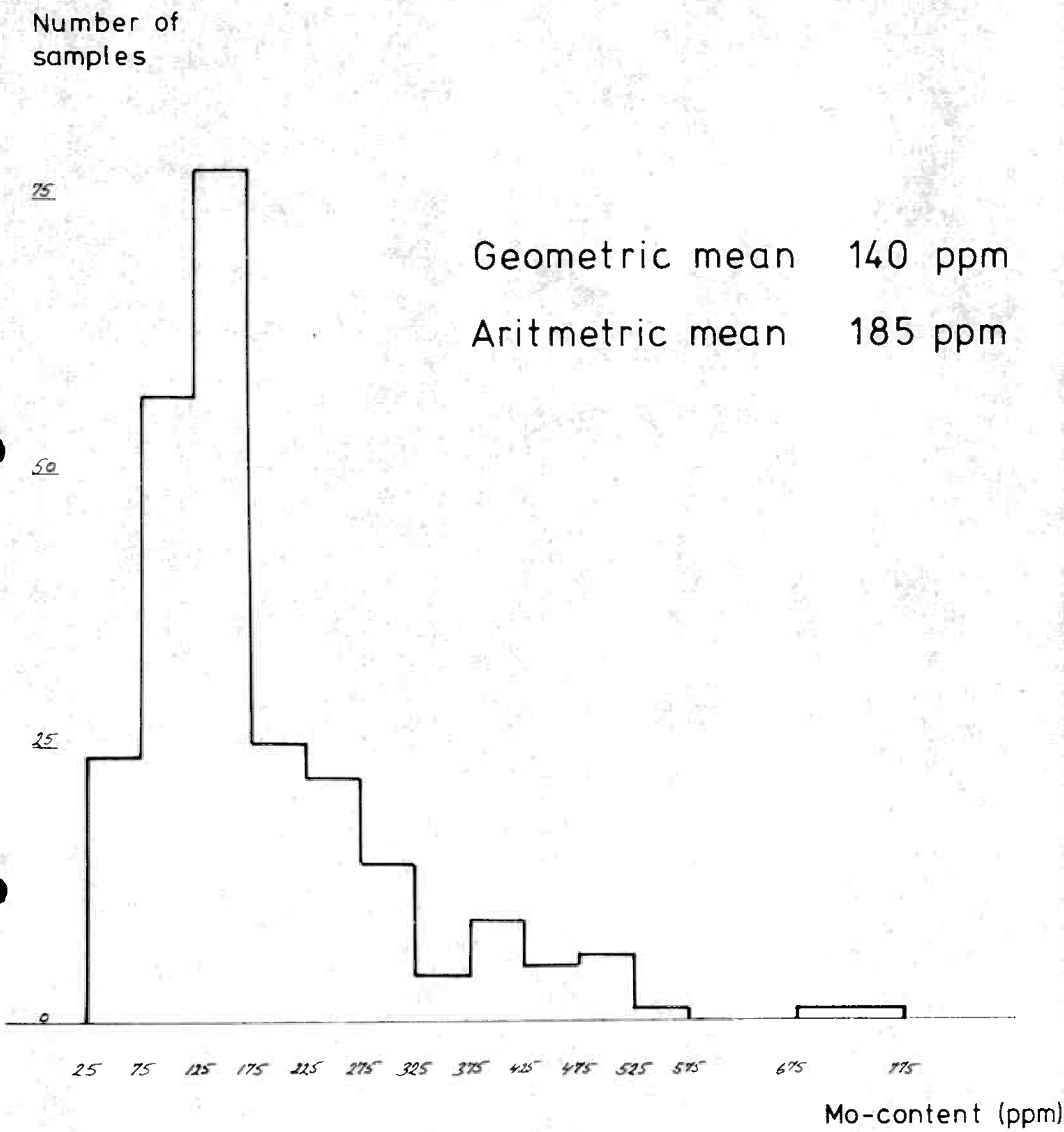

Fig. 8 Distribution of Mo-values in the Lille Knabetjern tailing pond. Total number of samples is 248.

LYNGDAL AREA

The investigated area .(Map 1) covers the eastern part of the Farsund intrusives and comprises a biotite granite (The Kleivan granite) and a hornblende granite (The Lyngdal granite), which have intruded grey gneisses (Middlemost, 1968). The granites are formed by anatexis of the crust, and it is assumed possible that a Mo-Cu bearing hydrothermal system of the porphyry type may has existed in connection with the granite intrusives.

Several minor MoS_2 showings occur in the grey, banded gneisses, and one MoS_2-showing (Mo skjerp no. 38o at Ås) is also reported to occur within the hornblende granite at Ås 4 km south of Lyngdal (Map 21). None of the present or pensioned farmers have ever heard about or seen this showing. So it most likely is misplaced on the map.

As a reconnaissance study of the 2oo km^2 area lo4 stream sediment samples have been collected and analyzed for Mo and Cu (Map 21 and Table 7).A minor portion of the samples (No 126 to 137) have also been analyzed for Pb and Sn (Table 7). Neither Mo, Cu or Sn show anomalous values. The highest Pb values (loo ppm in no 128 and 137) are assumed anomalous and most likely reflect lead mineralization. Anomalous and enlarged lead values occur in the southern part of the Kleivan granite, and at the east-end of the hornblende granite. Samples from these areas are also enlarged in Mo (5 to 7 ppm).

Two points of interest shall be noted. Investigations by N.G.U. in the Omlandsheie area in Vest-Agder show that in soil samples from above a molybdenite mineralization there exists a good correlation between Mo and Pb (Van der Weel, 198o). Further, from investigations in the Oslo-graben area it is known that the Mo-content in stream sediment samples not necessary reveals up-stream molybdenite mineralization.

Sample no	Cu (ppm)	Mo (ppm)	Sample no	Cu (ppm)	Mo (ppm)	Sample no	Cu (ppm)	Mo (ppm)
1	10	3	32	15	4	63	15	4
2	5	2	33	10	3	64	5	4
3	5	6	34	10	3	65	5	3
4	10	4	35	10	5	66	5	2
5	15	2	36	20	3	67	5	3
6	10	<2	37	15	2	68	5	2
7	5	2	38	10	2	69	5	2
8	5	2	39	10	3	70	5	<2
9	15	2	40	15	3	71	5	2
10	15	4	41	5	2	72	20	3
11	15	2	42	10	2	73	5	3
12	10	4	43	10	3	74	5	4
13	5	2	44	20	3	75	5	4
14	5	3	45	10	3	76	5	3
15	4	<2	46	10	4	77	5	3
16	5	2	47	10	2	78	5	3
17	10	<2	48	10	3	79	20	3
18	10	3	49	10	2	80	10	3
19	20	2	50	5	3	81	5	3
20	15	2	51	5	<2	82	5	4
21	5	4	52	15	2	83	5	3
22	5	3	53	5	2	84	10	4
23	5	2	54	5	2	85	10	2
24	5	2	55	5	3	86	5	3
25	30	3	56	5	3	87	5	5
26	10	2	57	10	3	88	10	7
27	15	<2	58	5	2	89	10	3
28	10	4	59	15	2	90	10	3
29	5	6	60	20	<2	91	10	<2
30	5	3	61	10	2	92	5	3
31	5	2	62	40	5			

Sample No	Cu ppm	Pb ppm	Sn ppm	Mo ppm
125	5	10	<5	2
126	5	15	<5	<2
127	20	75	5	2
128	10	100	<5	2
129	5	25	<5	<2
130	5	45	<5	3
131	10	30	<5	3
132	5	15	<5	4
133	5	25	<5	4
134	5	10	5	<2
135	10	10	<5	2
136	10	60	<5	4
137	15	100	<5	3

Table 7 Analyses of stream sediment samples from the Lyngdal area. No 125 is from the Ørsdalen river.

Allthough the "anomalies" are very weak and may just represent random high background values, there exist a possibility for Mo-mineralization in the southern part of the Kleivan granite and at the east end of the hornblende granite.

It is proposed to do minor supplementary prospection in the southern part of the Kleivan granite. It is recommended to do geological reconnaissance and collect soil samples (1o-2o samples/km^2) and have them analyzed for Mo and Pb.

(NGU ?)

VIKESÅ - ÅLGÅRD AREA

Introduction

The area is situated between Vikeså and Ålgård (Map 1). The geology is described by Michot (196o) and Hermans et al. (1975). The area comprises grey banded gneisses, rusty garnet gneisses, the Fauerfjeld metasediments and late-tectonic granitic intrusives in the area SW of Ålgård.

There is not reported any showings in the area, but on basis of the geological setting, the area was assumed potential for porphyry-type Mo-Cu mineralization within the granites, contact-type mineralization of Sn and W, stratabound Cu, Pb, Zn and $BaSO_4$ mineralization in the metasediments and Mo-W bearing quartz veins in the grey banded gneisses.

Activities

As a reconnaissance program 33 heavy-mineral samples and 51 stream sediment samples were collected within the 2oo km^2 area (Map 22). The heavy-mineral samples were counted for their scheelite content and further analyzed by a semi-quantitative multielement spectrographic method (Table 8). The stream sediments were analyzed for Sn, Cu, Mo, Pb, Zn and Ba (Table 9).

Results

All the heavy-mineral samples contain less than 3 grains of scheelite. Analyses of the heavy-mineral concentrates indicate that tin is anomalous in 5 samples (5o1, 5o2, 51o, 531 and 532, Table 8). These anomalies are not confirmed by analyses of the stream sediment samples. The highest content of lo ppm Sn occurs in quiet a different area. Check analyses of a few heavy-mineral samples (Table 8) indicates that the Sn-content not is anomalous.

Sample No	Ni	Zr	Na	Cu	Fe	Ti	Mo	V	Ca	Al	Si	Mg	Cr	Pb	Mn	Sn	Check Sn (ppm)
5o1	v	t	t	v	M	M	v	s	t	m	M	m	s	v	m	s	3o
5o2	s	s	m	v	M	M	v	s	t	m	M	m	s	v	m	s	25
5o3	v	t	m	v	M	M	v	s	t	m	M	m	s	v	m	v	
5o4	v	t	t	v	M	M	v	s	t	m	M	m	s	v	m	v	
5o5	v	t	t	v	M	M	v	s	t	m	M	m	s	v	m	-	
5o6	v	t	t	v	M	M	v	s	t	m	M	m	s	v	m	v	
5o7	s	t	t	v	M	M	v	s	t	m	M	m	s	v	m	v	
5o8	s	t	t	v	M	M	v	s	t	m	M	m	s	v	m	v	
5o9	v	t	t	v	M	M	v	s	t	m	M	m	s	v	m	-	
51o	v	t	t	v	M	M	v	s	t	m	M	m	s	v	m	t	35
511	v	t	t	v	M	M	v	s	t	m	M	m	s	v	m	-	
512	v	t	t	v	M	M	v	s	t	m	M	m	s	v	m	v	
513	v	t	t	v	M	M	v	s	t	m	M	m	s	v	m	-	
514	v	t	t	v	M	M	v	s	t	m	M	m	s	v	m	-	
515	s	t	m	v	M	M	v	s	t	m	M	m	s	v	m	v	
516	s	s	t	v	M	M	v	s	t	m	M	m	s	v	m	v	
517	s	t	t	v	M	M	v	s	t	m	M	m	s	v	m	-	
518	v	s	t	v	M	M	v	s	t	m	M	m	s	v	m	-	
519	v	s	t	v	M	M	v	s	t	m	M	m	s	v	m	-	
52o	v	t	t	v	M	M	v	s	t	m	M	m	s	v	m	-	
521	v	s	t	v	M	M	v	s	t	m	M	m	s	v	m	-	
522	v	t	t	v	M	M	v	s	t	m	M	m	s	v	m	v	
523	v	t	t	v	M	M	v	s	t	m	M	m	s	v	m	-	
524	v	s	t	v	M	M	v	s	t	m	M	m	s	v	m	-	
525	v	t	t	v	M	M	v	s	t	m	M	m	s	v	m	-	
526	v	t	t	v	M	M	v	s	t	M	M	m	s	v	m	-	
527	v	t	t	v	M	M	v	s	t	m	M	m	s	v	m	v	
528	v	t	t	v	M	M	v	s	t	m	M	m	s	v	m	v	
529	v	t	t	v	M	M	v	s	t	M	M	m	s	v	m	-	
53o	v	t	t	v	M	M	v	s	t	M	M	m	s	v	m	-	
531	v	s	m	v	M	M	v	s	t	m	M	m	s	v	m	s	25
532	v	s	m	v	M	M	v	s	t	m	M	m	s	v	m	s	2o
533	v	t	t	v	M	M	v	s	t	m	M	m	s	v	m	-	
534	v	t	m	v	M	M	v	s	t	m	M	m	s	v	m	-	

M >5 %

m o,5 - 5 %

t o.o5 - o,5 %

s 5o - 5oo ppm

v 5 - 5o ppm

Table 8 Semi-quantitative spectrographic analysis of heavy-mineral concentrates from the Vikeså-Ålgård area- Sample no 534 is from the Ørsdalen river.

Sample No.	Ba ppm	Zn ppm	Cu ppm	Pb ppm	Sn ppm	Mo ppm
93	900	95	15	10	<5	<2
94	390	290	15	170	<5	2
95	310	90	25	110	<5	<2
96	750	45	5	20	<5	<2
97	780	50	10	60	<5	2
98	940	55	10	15	<5	<2
99	620	80	20	45	<5	2
100	830	30	5	10	<5	<2
101	430	65	15	120	<5	<2
102	670	55	10	50	<5	<2
103	720	85	10	35	<5	<2
104	840	50	5	5	<5	<2
105	810	40	5	15	<5	<2
106	610	55	5	25	<5	<2
107	720	45	10	25	<5	2
108	270	180	20	150	<5	<2
109	690	95	15	45	<5	2
110	530	100	20	40	<5	5
111	640	60	15	40	<5	3
112	620	70	10	10	<5	<2
113	700	35	10	15	<5	2
114	670	40	10	10	<5	4
115	400	40	15	85	<5	3
116	660	45	10	10	<5	2
117	650	30	10	20	10	2
118	460	55	15	85	<5	2
119	750	35	5	20	<5	<2
120	650	50	10	10	<5	2
121	620	50	5	15	<5	<2
122	580	55	10	25	<5	3
123	640	45	5	5	<5	3
124	940	30	5	10	<5	2
138	590	40	10	50	<5	2
139	660	70	10	50	<5	2
140	670	55	15	15	<5	2
141	460	40	10	45	<5	2
142	560	40	10	45	<5	2
143	600	65	10	25	<5	<2
144	790	90	5	25	<5	<2
145	570	200	25	35	<5	2
146	510	85	5	15	<5	3
147	640	75	10	10	<5	<2
148	550	150	10	40	<5	2
149	670	50	5	5	<5	2
150	670	60	5	<5	<5	<2
151	780	50	10	20	<5	<2
152	360	350	50	280	<5	<2
153	470	95	15	80	<5	<2
154	600	50	15	75	<5	3
155	640	25	10	20	<5	2
156	770	25	5	10	<5	<2

Table 9 Analysis of stream sediment samples from the Vikeså-Ålgård area

The analyses of the stream sediments show that the content of Sn, Cu, Mo and Ba only represent background values. However, Pb and Zn show a large variation from 5 ppm to 28o ppm and from 25 ppm to 35o ppm respectively. Pb-values above 8o ppm and Zn-values above 15o ppm are assumed anomalous (Map 22). The most pronounced anomaly occurs 5 km north of Vikeså. In this area the Fauerfjeld metasediments form a NW-SE striking horizon dipping lo to 2o^{o} E (Hermans et al., 1975). The total thickness is up to 8o m. The lithology is very variable. At the bottom of the sequence above grey banded gneisses occurs 5-2o m thick, massive quartzite bed. It is followed by 1-2 m gneiss, a 1-5 m marble horizon and with a transitional contact to the marble a 5-2o m thick horizon of diopside-biotite schist. On top of the sequence follows grey banded gneiss. The Pb and Zn anomalous samples are collected at the foot of this profile. The source is not known but it is most likely that Pb-Zn mineralization must exist in one of the above mentioned rock types.

Recommendation

It is recommended to identify the source for the Pb-Zn anomalies in the area 5 km north of Vikeså. If it not can be done by field inspection, it is proposed to collect soil and rock samples from several profiles across the metasediments and have them analyzed for Pb and Zn

VIGLANDSVATN AREA

During Folldal Verk A/S's scheelite exploration in SW-Norway in 1971 several heavy-mineral samples from the area between Rusdalsvatn and Viglandsvatn were anomalous in scheelite grains (Map 1). The source has never been located.

The area comprises grey, banded gneisses and graphite-ironsulphide bearing gneiss (Hermans et al., 1975).

A traverse with UV-lamps did not locate any scheelite, but arose suspicion about the true position of the original samples. From prospection work by N.G.U. in the Ørsdalen area (Olerud, 198o) it is known that the tungsten content in stream sediments is a good indicator of W-mineralization. Therefore, 17 stream sediment samples were collected from a 4 km^2 area at Viglandsvatn which was suspected to host W-mineralization (Map 23). The samples have been analyzed for Cu and W (Table lo). All the analytical values represent background content. The scheelite in the heavy-mineral samples must obvious originate from very scattered sources.

No further work is recommended.

Sample number	Cu (ppm)	W (ppm)
157	15	<5
158	10	<5
159	10	<5
160	5	<5
161	10	<5
162	15	<5
163	5	<5
164	10	<5
165	5	<5
166	10	<5
167	5	<5
168	5	<5
169	10	<5
170	10	<5
171	5	<5
172	10	<5
173	5	<5

Table lo Analysis of stream sediment samples from the Viglandsvatn area.

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DIARY

Diary of the field activity during the exploration activity in 1982 in SW-Norway. For the period 2/6 - 26/6 abstracts from a diary of Jan Inge Tollefsrud are included.

24-5

Departure by car from Copenhagen at 15^{30}. With ferry from Hirtshals to Kristianssand.

25-5

Arrival at Ørsdalen 12^{30} where Limyr was waiting. Housed in a rented apartment in Ørsdalen. Discussed the program and visited Stoll I. Limyr left in the evening.

26-5 to 1-6

Mapping and inspection with UV-lamp of Stoll I.

2-6

Limyr arrived together with Sven Dahlgren and Jan Inge Tollefsrud. All the four of us , field equipment and food was by helicopter moved to the cabin at top of the mountain.

3-6

Reconnaissance of the terrain, visit to Schånningsgruben and in the night traversing with UV-lamps.

4-6

Discussion of the program with Limyr after which he left. Introduced Sven and Jan Inge to the rock units. Mapping of Norges Bank.

5-6 to 13-6

Mapping of the upper half of the valley wall by Sven and Jan Inge in scale 1:1ooo, and detail mapping around Schånningsgruben. Mapping on the mountain plateau, inspection of the old mines and compilation of previous investigations by JLP.

14-6

Moved down into the valley. Limyr arrived together with Per Erik Øverli. Discussion on the program.

15-6

Departure by Limyr and Sven. Mapping and traversing with UV-lamp of Stoll 2. Jan Inge introduced Per Erik to the rock units.

6-6 to 24-6
JLP on vacation. Jan Inge and Per Erik mapped the lower half of the mountain wall above Stoll 1 and 2. They also traversed selected areas with UV-lamps. They found several small with molybdenite and/or scheelite.
25-6 to 26-6
Geological reconnaissance and traverses with UV-lamps in the steep stream 25o m east of the entrance to Stoll I. Rust zones of garnet-hypersthene gneiss contain minor molybdenite and traces of scheelite.
27-6
Arrival by JLP in rented car from Sola and of Henrik Nielsen in his own car.
28-6
Departure by Jan Inge and Per Erik in the rented car. Planning of the field program for the next month.
29-6
Visit to the Gursli molybdenum mine.
3o-6 to 4-7
Moved to Lyngdal and housed in a hostel. Collection of 92 stream sediment samples from a 2oo km^2 area.
5-7
Inspection of the old Fe-Ti skjerp at Rosfjord. It is minor concentrations of titano-magnetite at the contact of quartz veins enclosed in hornblende granite. Failed to find the molybdenum skjerp at Ås 4 km south of Lyngdal. Returned to Ørsdalen
6-7
Went to the mountain plateau. Mapping of the adit to Strossekrateret. The cabin was closed and prepared for the winter.
7-7
The stream sediment samples from the Lyngdal area were posted to England for analysis. Planning of the next few days work.
8-7 to 12-7
Collection of heavy-mineral samples and stream sediment samples in the area between Vikeså, Ålgård and Undheim. One of the days also reconnaissance along the horizon of the Fauerfjeld metasediments in the area 5 km north of Vikeså.

13-7
Collection of one heavy-mineral sample (no 534) and one stream sediment sample (no 125) from the Ørsdalen river at the bridge. Traverses during nighttime with UV-lamps in the road tunnel from Austrumsdal to Ørsdalen did not locate any scheelite. Traverses along the road from Hofreistovatn to Austrúmdalen resulted in the finding of a little scheelite in amphibolitic rocks at two localities. One at the east-end of Hofreistovatn and one at the west-end of Austrumdalsvatn.
14-7 to 15-7
Drove to Moi and traversed during nighttime a restricted area between Rusdalsvatn and Viglandsvatn. No scheelite was found.
16-7
Drove to Farsund. A magnetic anomaly within the charnocite at Ulgjell 9 km NW of Farsund was visited. The area comprises a biotite granite with cm-thick titanomagnetite-bearing pegmatites at the contact between granite and charnocite. Continued the effort to locate the Mo-skjerp at Ås. We spoke to the man who had been living on the farm with the assumed skjerp from c. 19oo to 197o. He had never heard about a Mo-skjerp in the area.
17-7
Drove to Lindefjeld in Kvinesdal in order to traverse a scheelite anomaly with UV-lamps. The area was covered with forest. We gave up and returned to Ørsdalen.
18-7
A day off.
19-7
Visit to Stavanger for buying various equipment and a ticket to Denmark for Henrik.
2o-7
Henrik went on vacation. Heavy-mineral samples posted to England.
21-7
Visit to Bergmester kontoret in Bergen together with Limyr.
22-7
Visit to the Fauerfjeld metasediments 5 km north of Vikeså for collection of samples from the quartzite bed.

23-7

JLP went for vacation in Denmark.

2-8

JLP and Henrik left Copenhagen in the morning and arrived at Ørsdalen in the evening.

3-8

Visit by Limyr and the managing director of Norske Fina A/S.

4-8

Packing of all the field equipment and left Ørsdalen. Visit to Gursli together with Limyr. Arrived at Knaben in the evening, where we settled in a rented house.

5-8 to 24-8

Limyr left the 5-8. During the period sampling of the tailing at Knaben II was performed by a local contractor - Tom Røjnestad - with the assistence of Henrik. JLP did geological reconnaissance in the entire Knaben Mo-field, studied the old reports, supervised the sampling of the tailing and prepared a preliminary report. From 7-8 to 8-8 Henrik went to the Lyngdal area and collected additional stream sediment samples. The 14-8 JLP and Henrik went to the Vikeså-Ålgård area for collection of additional stream sediment samples. We stayed overnight in Ørsdalen. The 15-8 we collected stream sediment samples in the Viglandsvatn area and returned to Knaben.

25-8

Packing of the drilling equipment. Limyr arrived in the afternoon. General discussion on the geology and of the potential for mineralization.

26-8 to 27-8

Limyr left in the morning. JLP and Henrik drove to Moi, where we meet Tom Røjnestad and Egil Jørgensen. With a leight weight pumping equipment it was attempted to empty a water-filled shaft at the old Gursli mine. The project failed. We returned to Knaben.

28-8

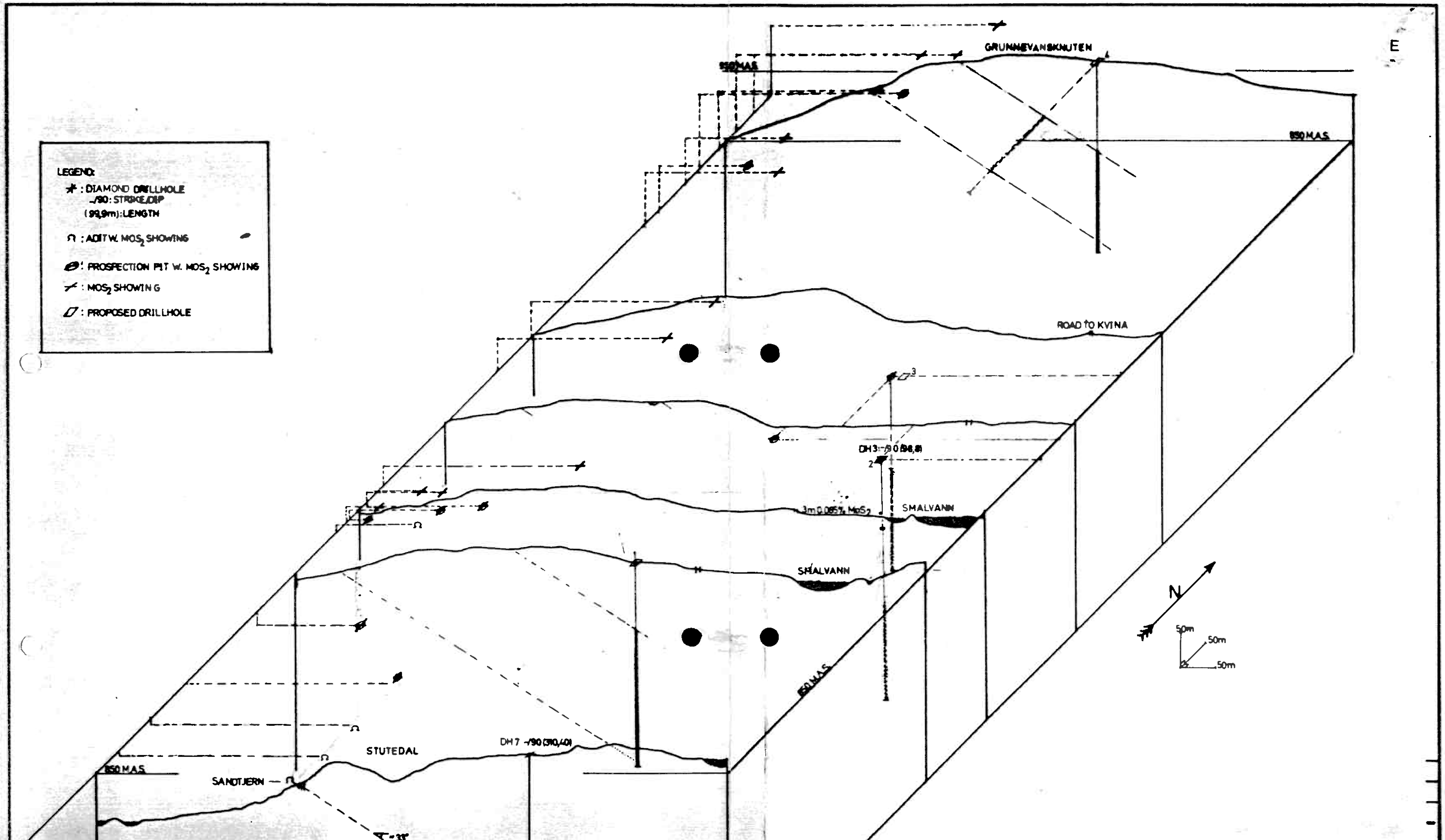
Packing of all field equipment.

29- 8

Left Knaben. Visited the old Mo-mine at Dalen in Telemark. Stayed overnight in Drammen.

3o-.8

Visit to the office of Norske Fina A/S in Oslo. Presented the results of the summers activities for Limyr and Heim. Continued to Copenhagen in the afternoon.



BLOCK DIAGRAM:
MoS_2 SHOWINGS,
PROPOSED DH.-POSITIONS

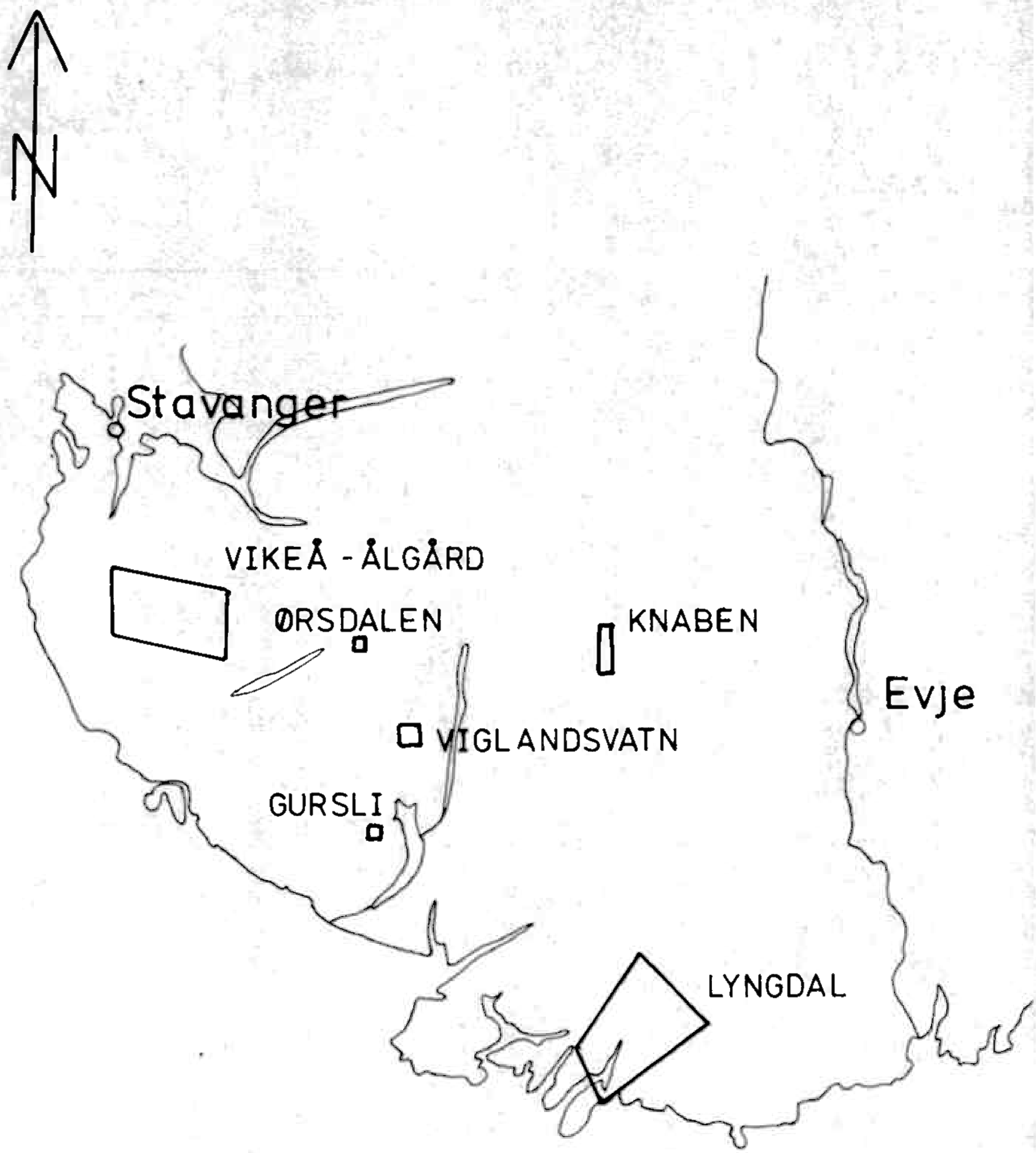
SANDTJERN-GRUNNEVANNSKNUTEN

Målestokk	Tegn.	
1:5000	Trac.	
	Kfr.	

Erstatning for:

Erstattet av:

A.S Tarrkopi A 3



MAP 1

NORSKE FINA A/S

Locality map
SW - NORWAY

1:1000000

JLP oct 82


LEGEND
Quartz vein
Hornblende gneiss
Amphibolite
Quartz-feldspar gneiss (granulite)
Biotite gneiss
Garnet-hypersthene gneis
W Mo Fe
Major and minor occurrences of scheelite/wolframite, molybdenite and ironsulphides (minor occurrences on the mountain plateau is not shown, see Nyegaard, 1981)
Strike/dip of foliation/contact
MAP 2
NORSKE FINA A/S
Geological/Mineralization map
VALLEY WALL AND MOUNTAIN PLATEAU
MINING AREA
ØRSDALEN
1:1000
JLP oct 82


LEGEND
QUARTZ - FELDSPAR GNEISS
BIOTITE GNEISS
HORNBLENDE GNEISS
(GARNET -) HYPERSTHENE GNEISS
AMPHIBOLITE
PEGMATITE / QUARTZ VEIN
W Mo W MAJOR AND MINOR OCCURRENCE OF SCHEELITE AND MOLYBDENITE
STRIKE/DIP OF FOLIATION
STRIKE/DIP OF FAULT
FAULT/JOINT ZONE
A little scheelite in leucocratic veins in amphibolite
Aggregates of scheelite and molybdenite along the contact of small quartz veins. Overall content a 20 cm wide zone with ~0,1% W
172,6 M
75680
22160
75640
22040
75600
22080
75560
MAP 3
NORSKE FINA A/S
Geological map
STOLL 1, PLATE 1
ØRSDALEN
1:200
JLP sep82

LEGEND: see map STOLL 1, PLATE 1

MAP 4

NORSKE FINA A/S

Geological map
STOLL 1, PLATE 2
ØRSDALEN
1:200

JLP sep 82

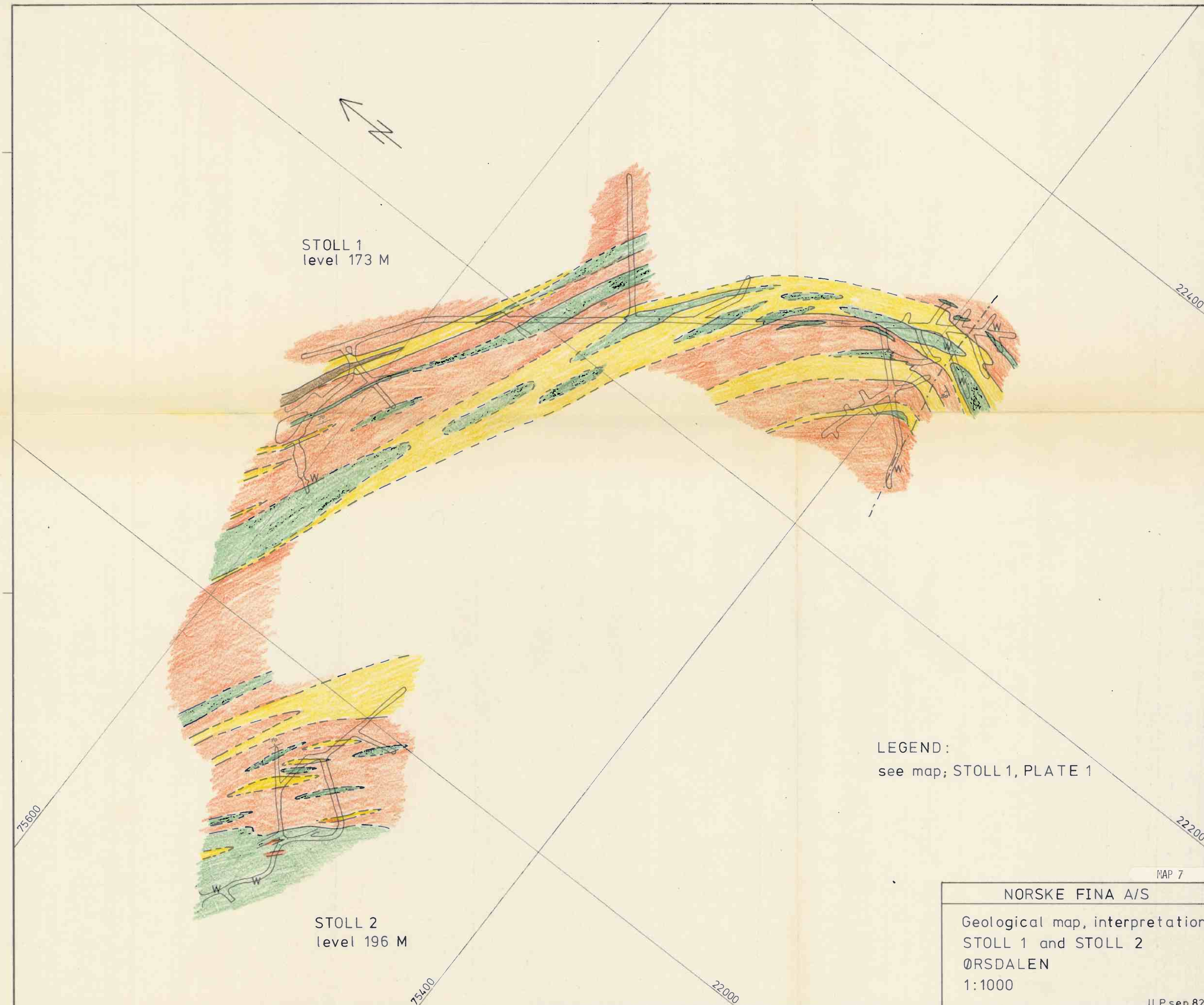

A little scheelite
in leucocratic veins
in the amphibolite
Aggregates of scheelite
enclosed in amphibolites
and along the contact of small quartz lenses
App. 0,5 % W over 1 m²
A little scheelite in
leucocratic veins in
amphibolite
Aggregates and
grains of scheelite
in leucocratic veins and
at the contact of quartz lenses
within the amphibolite
Overall content in the crosscut
≤ 100 ppm W. It is the most
rich mineralization in STOLL 1
Within the shearzone
1 m² with 0,1-0,5 % W
LEGEND: see map STOLL 1, PLATE 1
75440
22360
75400
22240
75360
75320
22280
22320
MAP 5
NORSKE FINA A/S
Geological map
STOLL 1, PLATE 3
ØRSDALEN
1:200
JLP sep 82

MAP 6

NORSKE FINA A/S

Geological map
STOLL 2
ØRSDALEN
1:200

JLP sep 82


STOLL 1
level 173 M
STOLL 2
level 196 M
LEGEND:
see map; STOLL 1, PLATE 1
22400
22200
22000
75600
75400
W
MAP 7
NORSKE FINA A/S
Geological map, interpretation
STOLL 1 and STOLL 2
ØRSDALEN
1:1000
JLP sep 82

LEGEND: see map; STOLL 1, plate 1

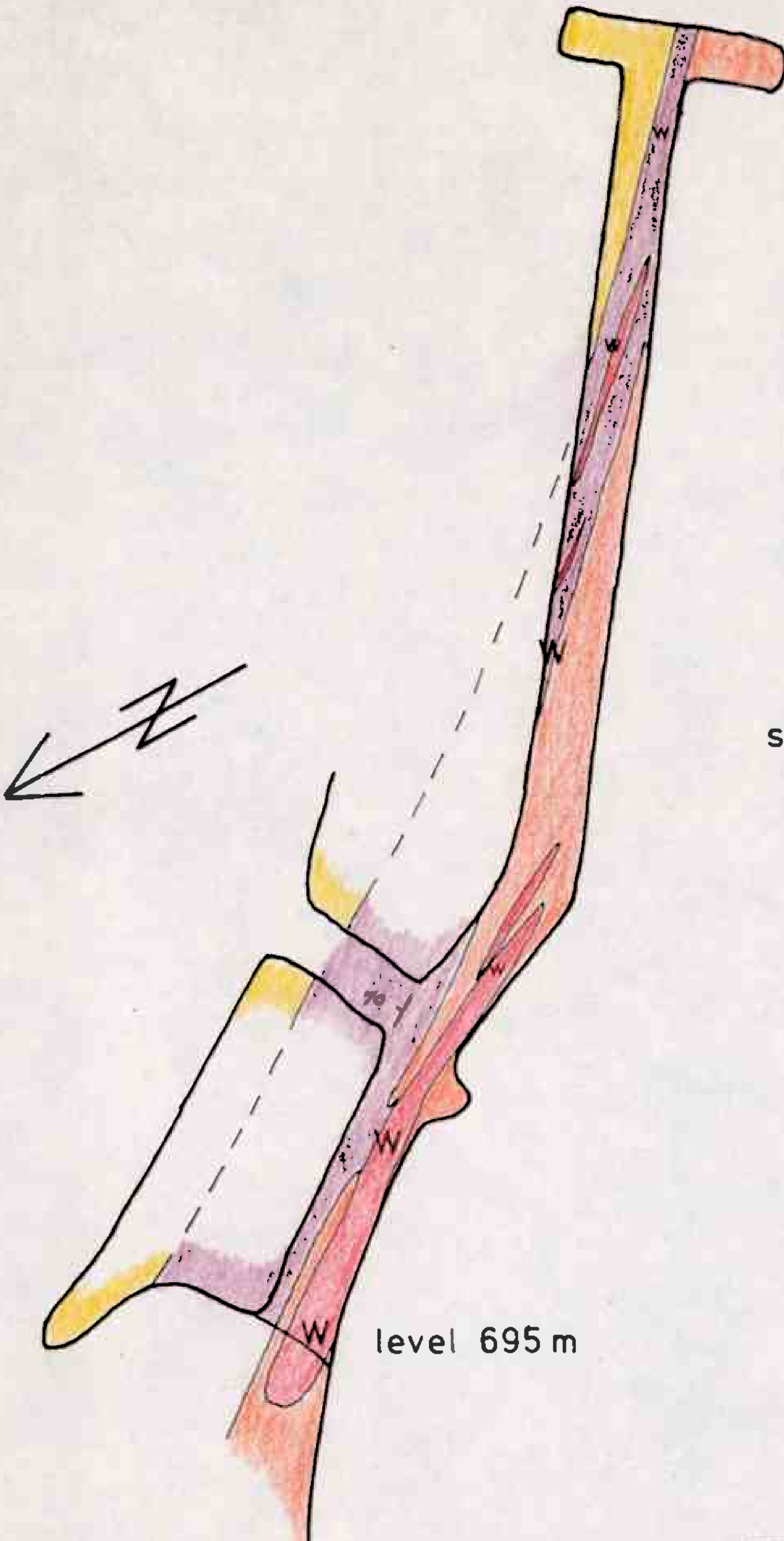
MAP 8

NORSKE FINA A/S

Geological map
Transportstoll, Strossekrater
ØRSDALEN
1:200

JLP sep82

A1 TLF. (02) 57 €311



Legend:

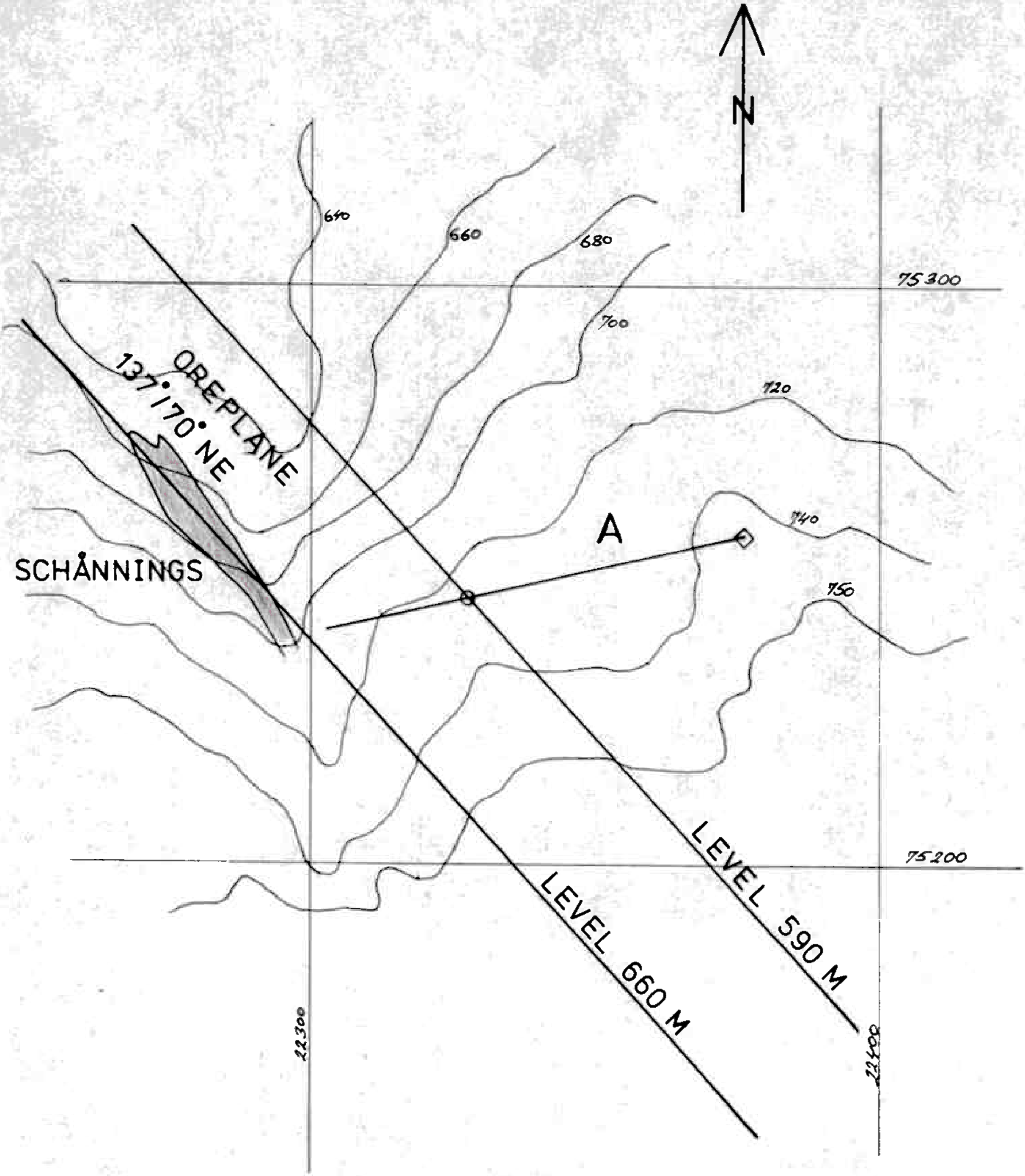
see map: STOLL 1, plate 1

MAP 9

NORSKE FINA A/S
Geological map Norges Bank, ØRSDALEN 1:200

JLP sep 82


NW
SE
Illustration of the size of a 0,5 mill. tons orebody
AREA 33000 m2
THICKNESS 5 m
DENSITY 3
WOLFRAM -
SYNKEN / STROSSEN
STROSSEKRATER
800
700
600
500
400
300
200
100
DDH 5 4 3 2
B
C
D
DDH 1
DDH 227
DDH 232
DDH 230
SCHÅNNINGS
DDH 228
DDH 232
DDH 231
A
600 M
OUTCROP
DDH 229
DDH 233
Trend of foldaxis
STOLL 1
PREVIOUS DRILLING
Intersection with supposed oreplane (142°/ 75° NE) of Wolframsynken
Intersection with the supposed oreplane (137°/ 70° NE) of Schånningsgruven
DRILLING PROGRAM - PROPOSAL
Planned intersection with oreplane of Strossekrateret
Planned intersection with oreplane of Schånningsgruven
MAP 10
NORSKE FINA A/S
Length profile
Mineralized horizon
ØRSDALEN
1:2000
JLP oct 82



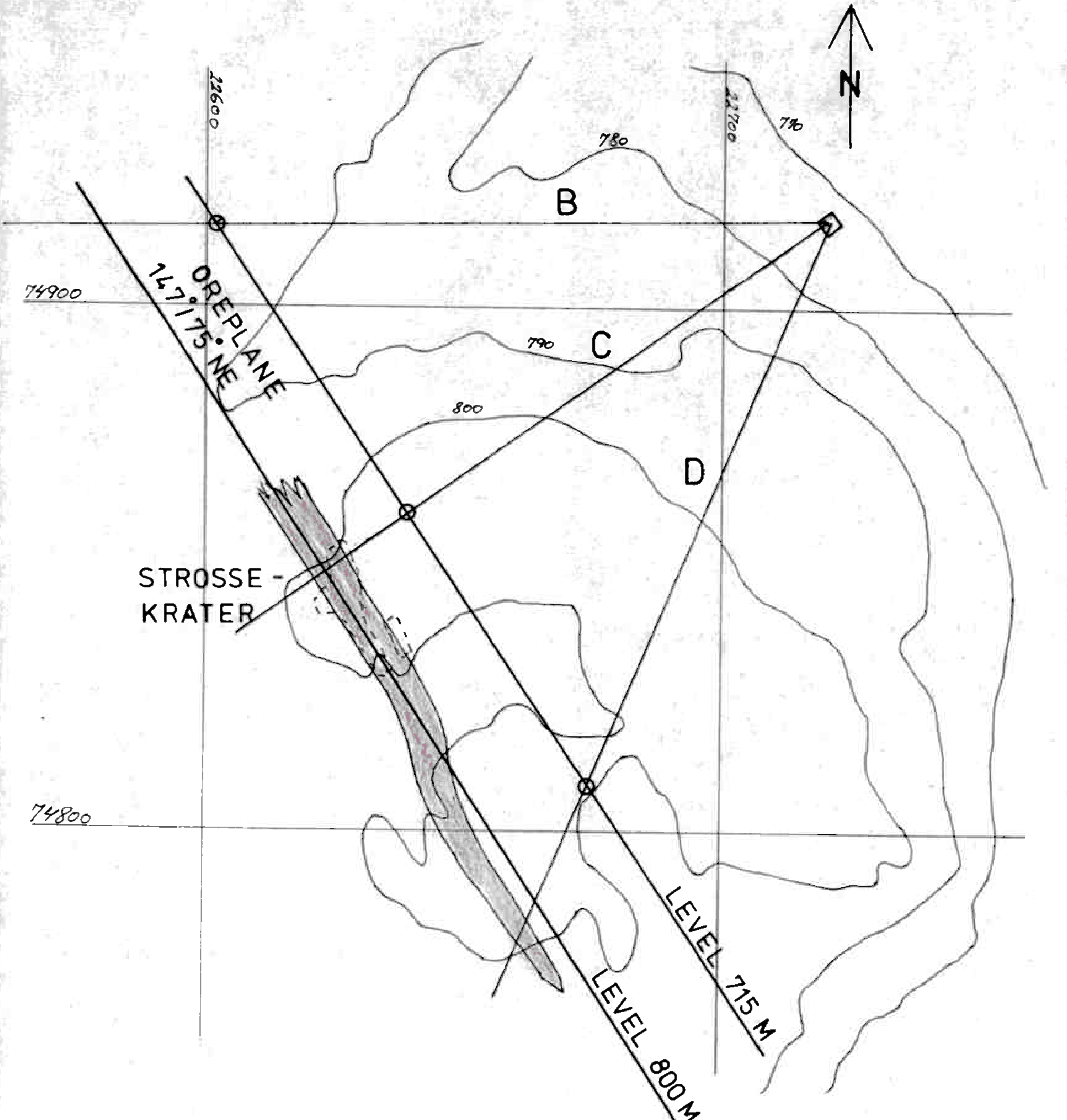
DRILLHOLE	DIRECTION	DIP	LENGTH
A	259°	72°	230 M

MAP 11

NORSKE FINA A/S

Drilling program - PROPOSAL
SCHÅNNINGSGRUVEN
ØRSDALEN
1:1000

JLP oct 82



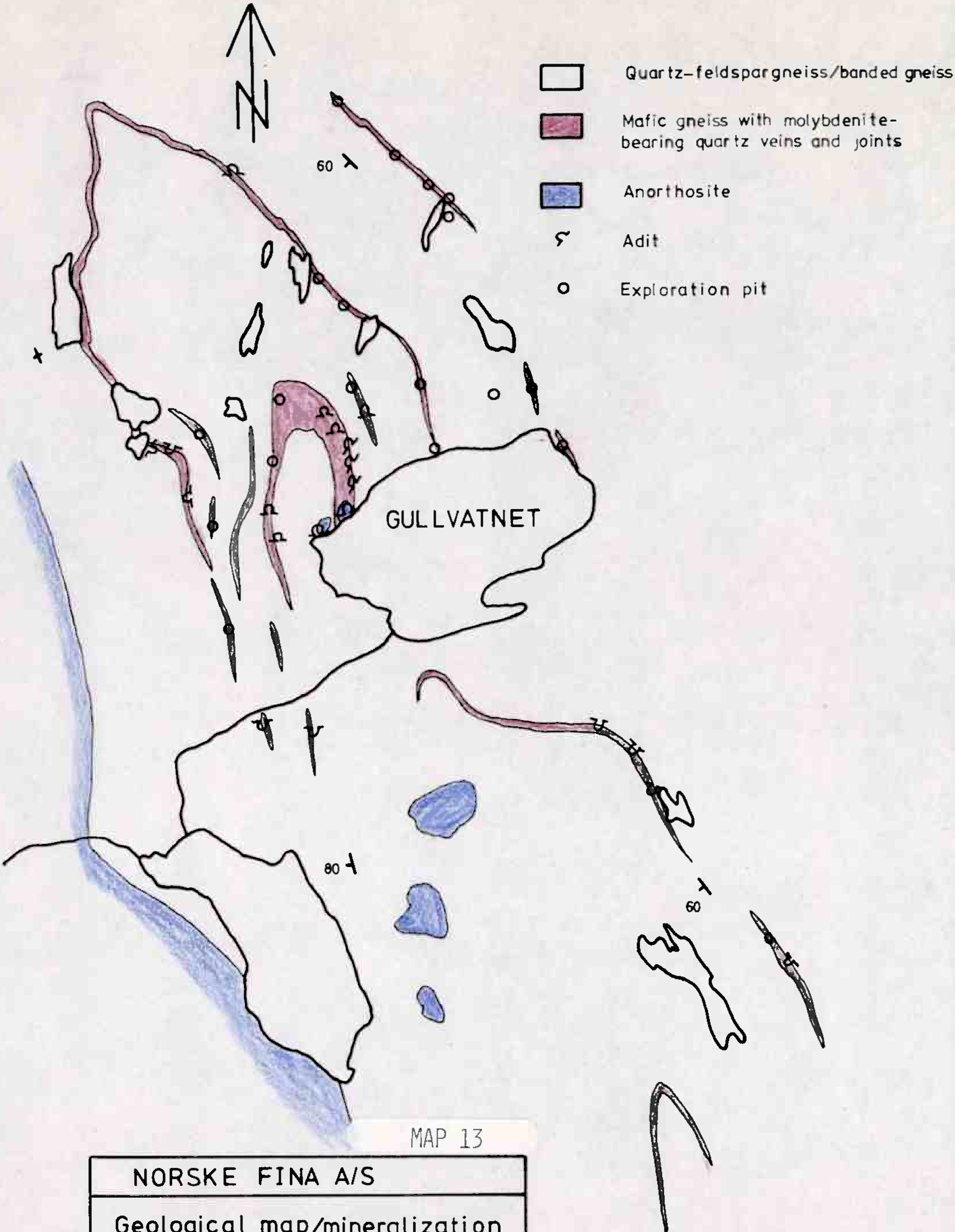
Drillhole	Direction	Dip	Length
B	270°	27°	165 m
C	235°	31°	145 m
D	204°	28°	180 m

MAP 12

NORSKE FINA A/S

Drilling program - PROPOSAL
STROSSEKRATER
ØRSDALEN
1:1000

JLP oct 82

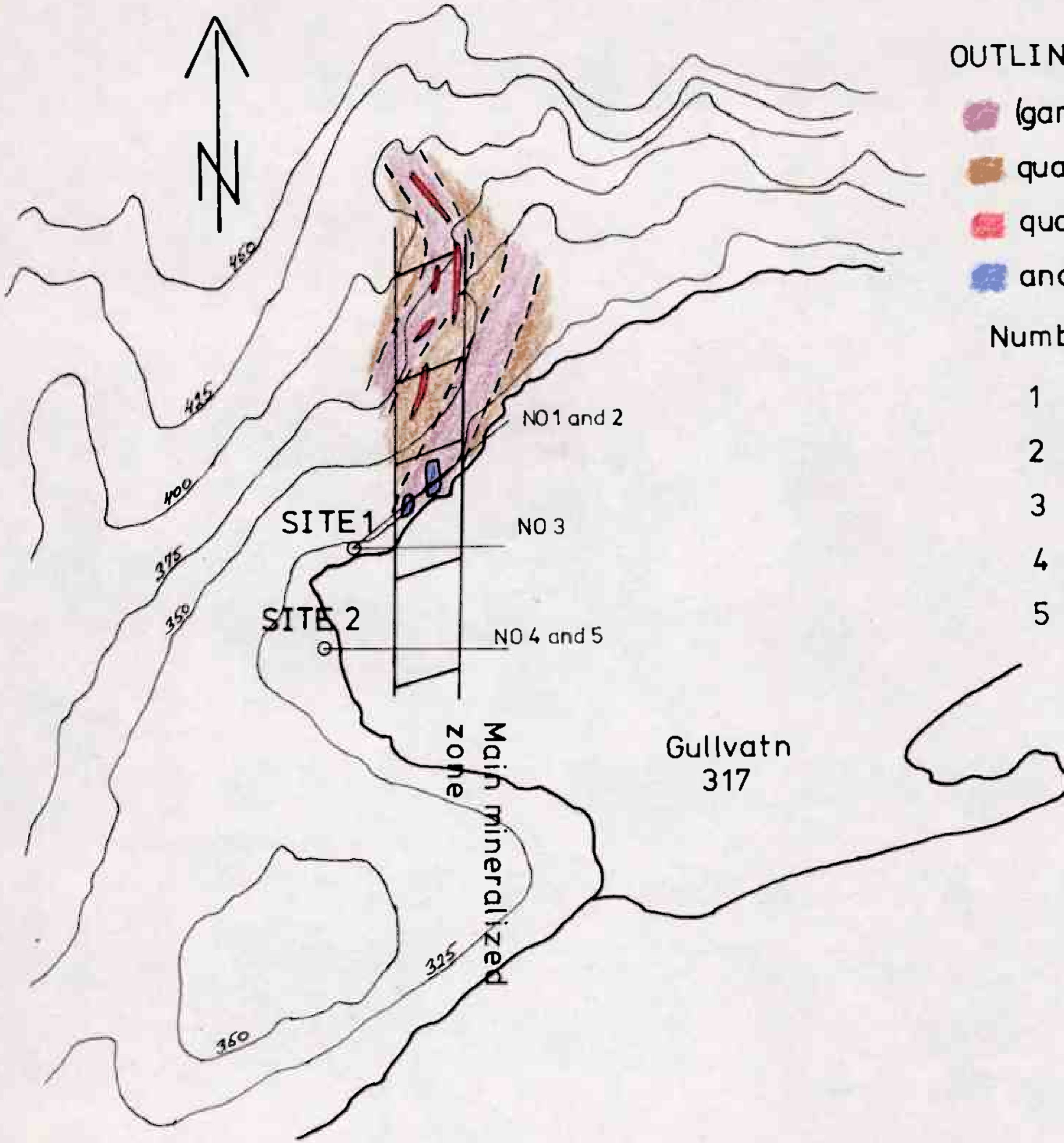


MAP 13

NORSKE FINA A/S

Geological map/mineralization
GURSLI AREA
c. 1:15000

JLP sep 82



OUTLINE OF GEOLOGY AT THE 320M LEVEL

- (garnet)-biotite gneiss
- quartz-feldspar gneiss
- quartzvein with MoS_2
- anorthosite ($\pm MoS_2$)

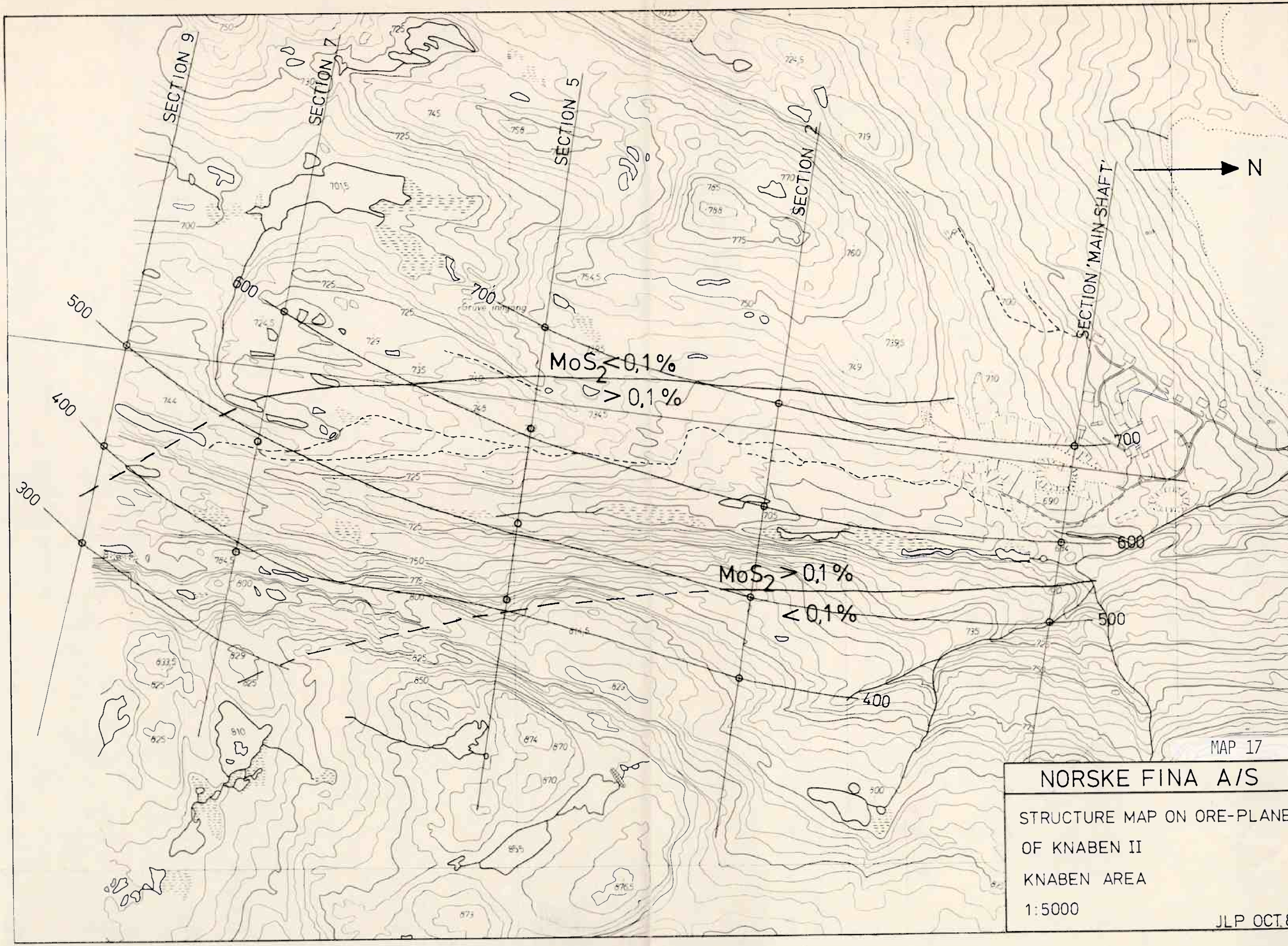
Number	Direction	Dip	Expected length
1	50°	30°	110 m
2	50	62	160
3	90	52	110
4	90	36	150
5	90	60	190

MAP 14

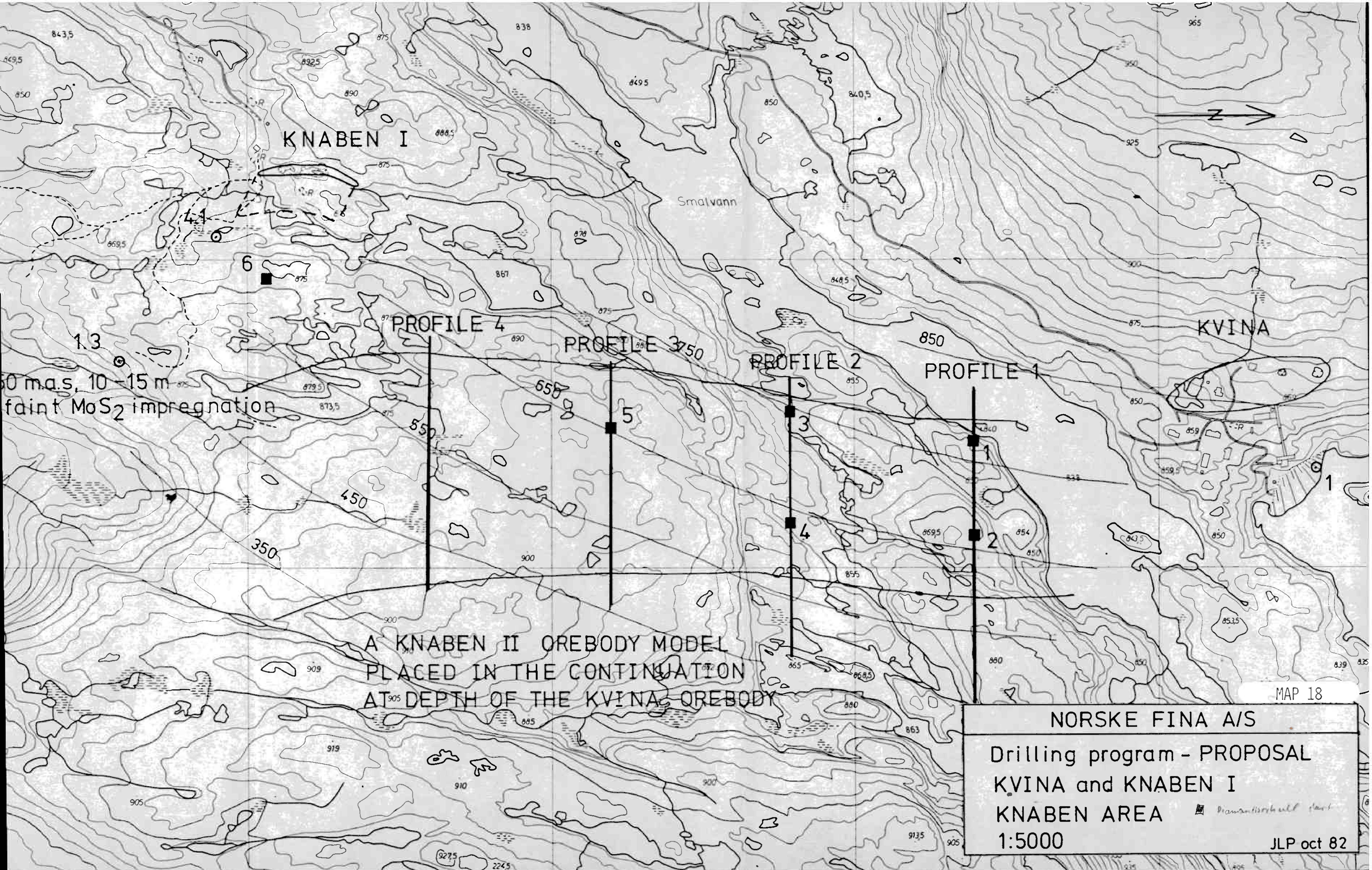
NORSKE FINA A/S
Proposal, drilling program GURSLI 1:5000 JLP sep82

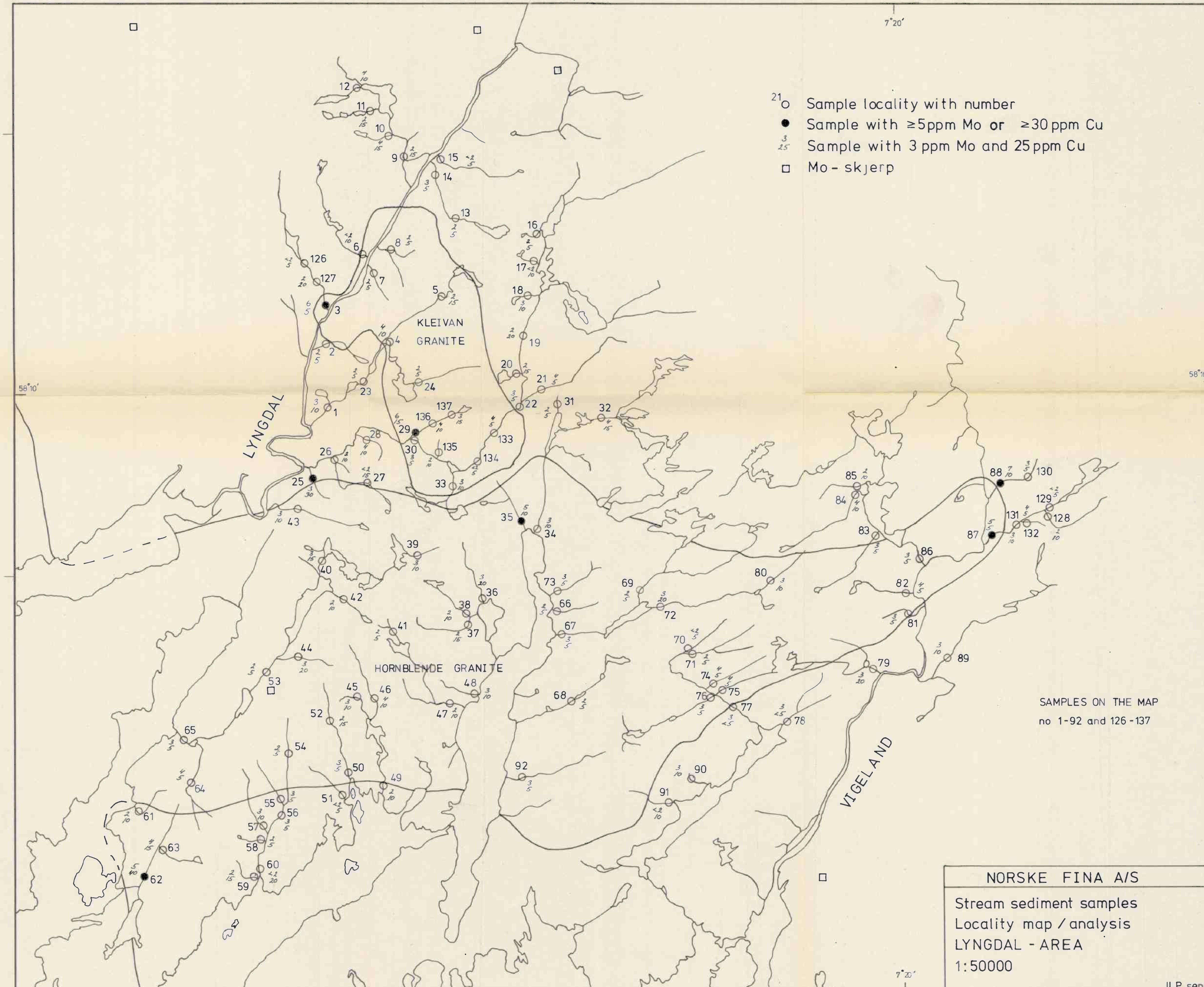
KNABEN II
BENKEHEI
ØRNEHOMMEN
REINSHOMMEN
ROMA
SECTION 9
SECTION 7
SECTION 5
SECTION 2
SECTION MAIN SHAFT
LEGEND
RED GRANITE
GREY GNEISSES MIXED WITH RED GRANITE
GANGFJELL (BLEACHED RED GRANITE)
DOLERITE
DIAMOND DRILLHOLE, number 3.1, direction 287°, dip 60°, length 53,26 m.
ADIT WITH MoS_2 SHOWING
PROSPECTION PIT WITH MoS_2 SHOWING
MoS_2 SHOWING
STRIKE/DIP OF FOLIATION
MAP 15
NORSKE FINA A/S
Geological/mineralization map
KNABEN II
KNABEN AREA
1: 5000
JLP oct 82

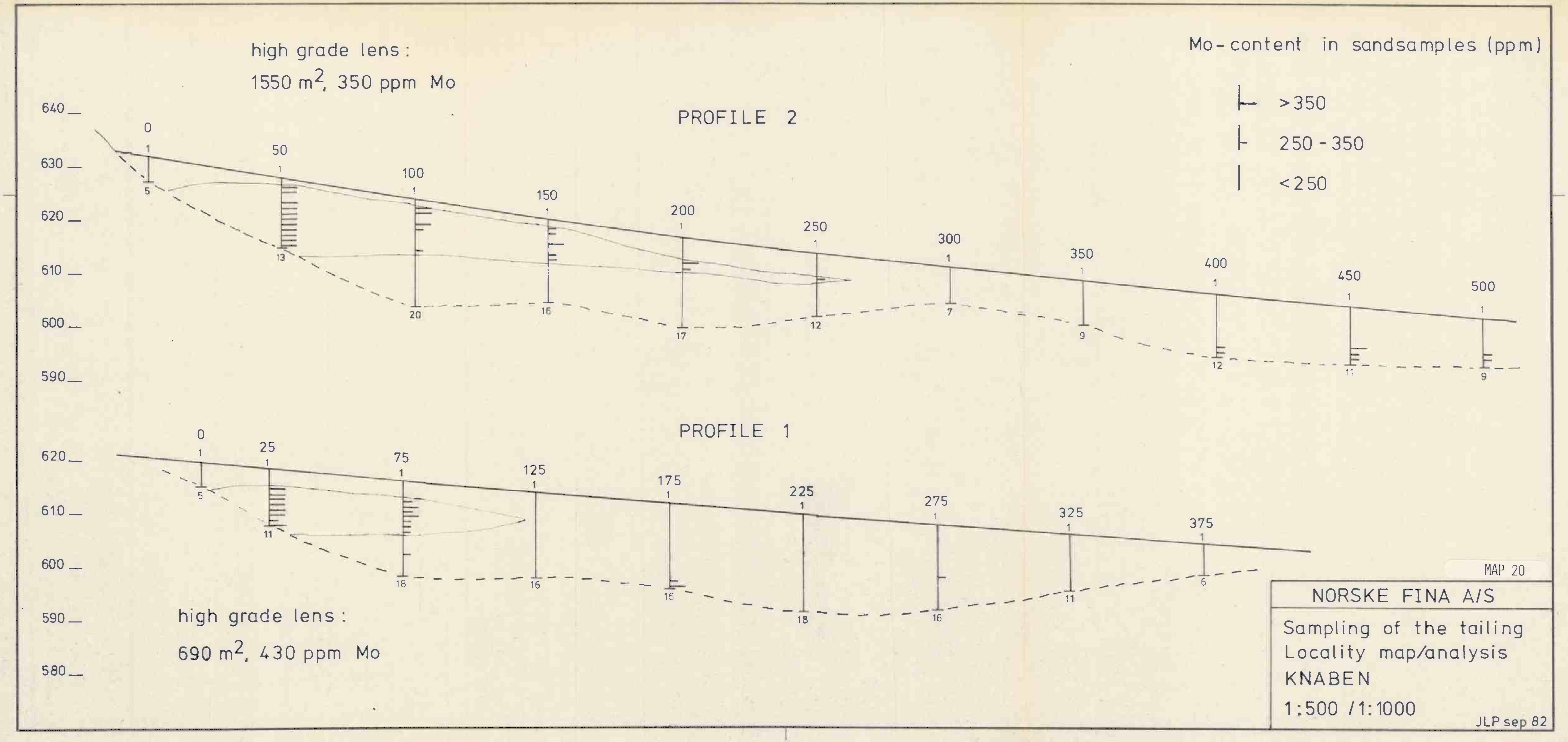
LILLE KNABEN
KNABEN I
SPILLEBROK SKJERP
Smalvann
SMALVANN CU-SKJERP
KVINA
Sandtjern
Bergtjern
LEGEND : see map of KNABEN II
after GUSTAVSEN 1970-1973
MAP 16
NORSKE FINA A/S
Geological/mineralization map
KNABEN I - KVINA
KNABEN AREA
1:5000
JLP oct 82



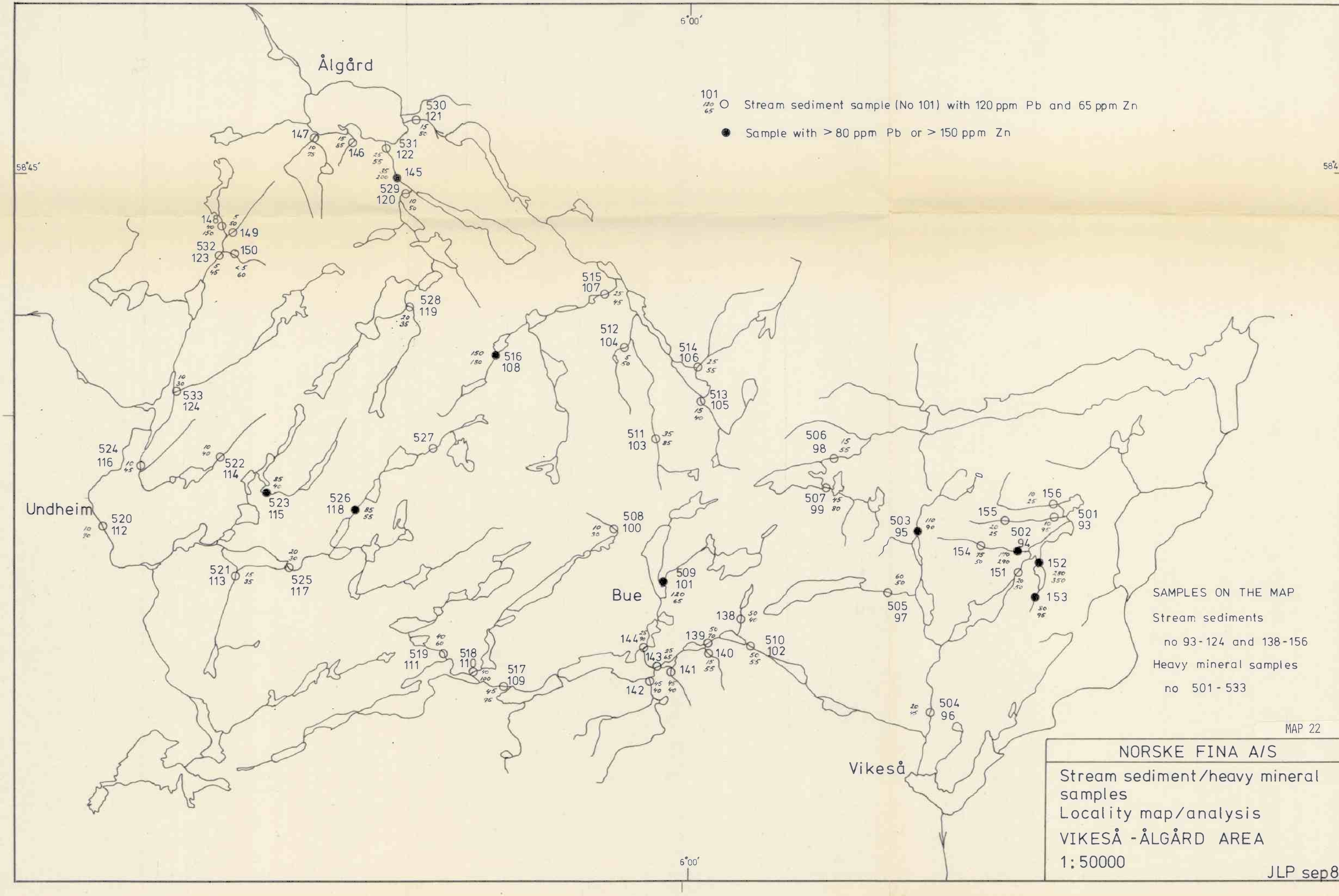
SECTION 9
SECTION 7
SECTION 5
SECTION 2
SECTION 'MAIN SHAFT'
N
500
600
700
400
300
MoS2 < 0,1 %
> 0,1 %
MoS2 > 0,1 %
< 0,1%
700
600
500
400
Gruve inngang
MAP 17
NORSKE FINA A/S
STRUCTURE MAP ON ORE-PLANE
OF KNABEN II
KNABEN AREA
1:5000
JLP OCT.82

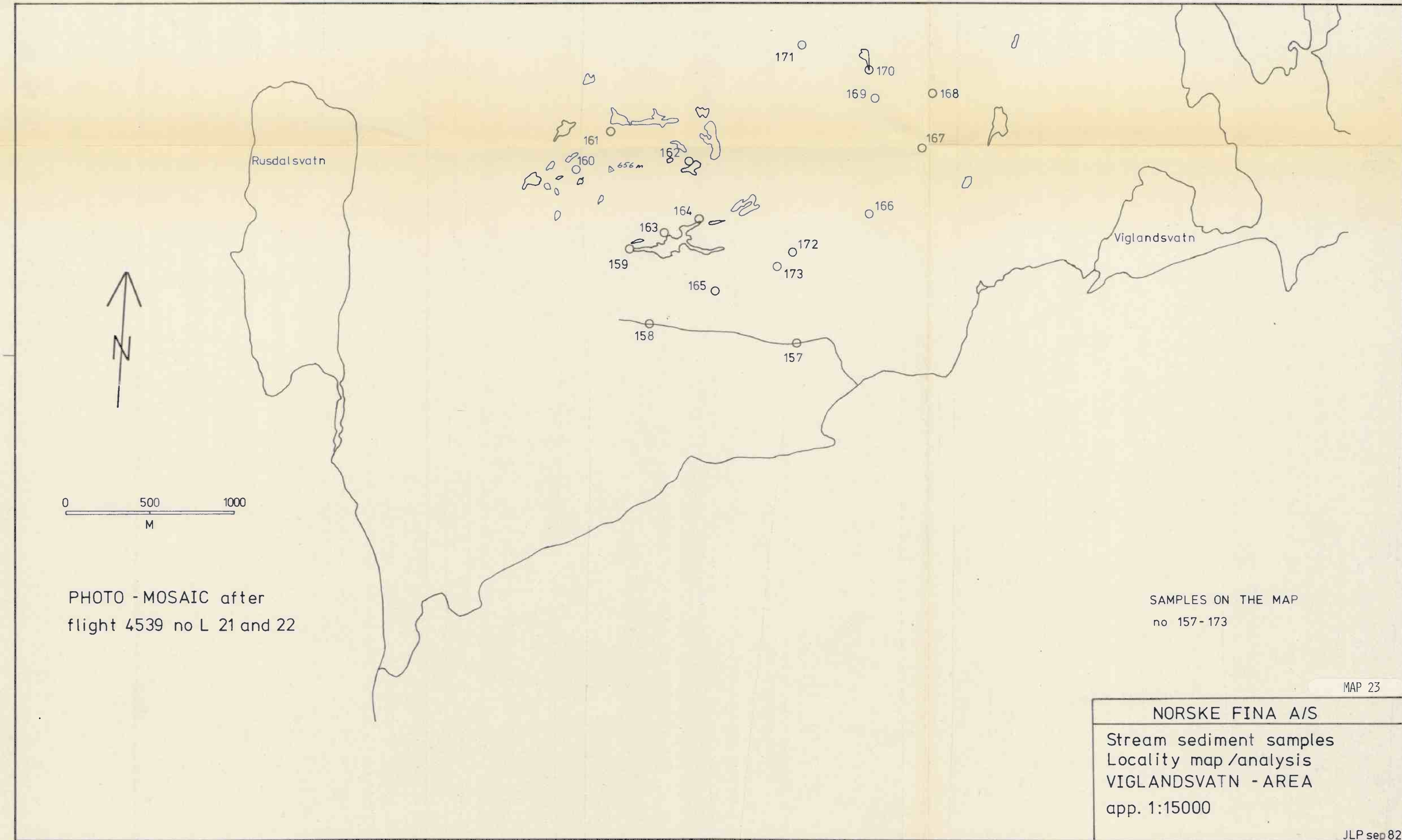

KNABEN I
Smalvann
KVINA
PROFILE 4
PROFILE 3
PROFILE 2
PROFILE 1
0 m.a.s. 10 - 15 m
faint MoS_2 impregnation
A KNABEN II OREBODY MODEL
PLACED IN THE CONTINUATION
AT DEPTH OF THE KVINA OREBODY
MAP 18
NORSKE FINA A/S
Drilling program - PROPOSAL
KVINA and KNABEN I
KNABEN AREA
1:5000
JLP oct 82


7°20'
21 ○ Sample locality with number
● Sample with ≥5ppm Mo or ≥30 ppm Cu
3/25 Sample with 3 ppm Mo and 25 ppm Cu
□ Mo - skjerp
58°10'
KLEIVAN GRANITE
LYNGDAL
HORNBLENDE GRANITE
VIGELAND
SAMPLES ON THE MAP
no 1-92 and 126-137
NORSKE FINA A/S
Stream sediment samples
Locality map / analysis
LYNGDAL - AREA
1:50000
JLP sep82



high grade lens :
1550 m2, 350 ppm Mo
Mo-content in sandsamples (ppm)
>350
250 - 350
<250
PROFILE 2
PROFILE 1
640
630
620
610
600
590
580
0
50
100
150
200
250
300
350
400
450
500
25
75
125
175
225
275
325
375
high grade lens :
690 m2, 430 ppm Mo
MAP 20
NORSKE FINA A/S
Sampling of the tailing
Locality map/analysis
KNABEN
1:500 /1:1000
JLP sep 82


6°00'
58°45'
58°45'
Ålgård
Undheim
Bue
Vikeså
101 120 65 ○ Stream sediment sample (No 101) with 120 ppm Pb and 65 ppm Zn
● Sample with > 80 ppm Pb or > 150 ppm Zn
SAMPLES ON THE MAP
Stream sediments
no 93 - 124 and 138 - 156
Heavy mineral samples
no 501 - 533
MAP 22
NORSKE FINA A/S
Stream sediment/heavy mineral samples
Locality map/analysis
VIKESÅ - ÅLGÅRD AREA
1:50000
JLP sep82


Rusdalsvatn
171
170
169
168
161
162
160
656 m
167
166
164
163
159
172
173
165
158
157
Viglandsvatn
N
0
500
1000
M
PHOTO - MOSAIC after
flight 4539 no L 21 and 22
SAMPLES ON THE MAP
no 157 - 173
MAP 23
NORSKE FINA A/S
Stream sediment samples
Locality map / analysis
VIGLANDSVATN - AREA
app. 1:15000
JLP sep 82